Preliminary Engineering Report

Tucson Drive Project

Lexington, Kentucky

September 24, 2014

Prepared for:

Lexington-Fayette Urban County Government

Division of Water Quality

engineering | architecture | geospatial

Prepared by:

GRW Engineers, Inc.

Lexington, Kentucky

Executive Summary

GRW Engineers, Inc. was retained by the LFUCG to assist with one of the Supplemental Environmental Projects required in the Consent Decree: Identify near-term flood relief or elimination actions that result in at least $30 million in capital flood mitigation projects. This preliminary engineering report is one of the capital flood mitigation projects.

This preliminary engineering report includes a description of the flooding problem, documentation of resident's concerns (gathered from questionnaires and meetings), viable mitigation alternatives, identification of pitfalls such as easement acquisition, and opinions of probable costs for final design, easement acquisition, and construction.

In 2012, questionnaires were sent to residents of the Tucson Drive neighborhood to determine the extent and causes of flooding in the neighborhood.

Flooding Questionnaire Summary 2012

Address	Flooding Reported		Comment
	Home	Street	
2220 Tucson Drive	No	Yes	Seeped through walls (1)
2221 Tucson Drive	Yes	Yes	Crawlspace (3+)
2230 Tucson Drive	No	Yes	Basement, Sump Pump Failure (3+)
2231 Tucson Drive	Yes	Yes	Storm Drainage into Crawlspace (3+)
2250 Tucson Drive	No	Yes	During Power Outage Caused Sump Pump Failure (1)
679 Hill N Dale	No	No	Seepage in basement (1)
686 Hill N Dale	No	No	Seeps through Cracks in Basement (3+)
682, 687, and 691 Hill N Dale Road	No	No	
616 and 609 Burbank Court	No	No	

* (#) – Number of times home flooded

An engineering survey has been completed in the area. The survey data was used to create a model and verify the placement of existing structures. Alternatives were tested using the preliminary model created from survey data.

GRW has identified three viable alternatives that will mitigate both yard and street flooding in the Tucson Drive project area but are unacceptable due to a lack of downstream capacity. Three additional alternatives that solve the Tucson Drive flooding and provide detention to accommodate the lack of downstream capacity were developed.

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1. SCOPE OF WORK

The project is listed as "Tucson Drive" on the Stormwater Priority Projects Master List.

Project Priority and Name		Water-shed	Council District	Severity Score	CPI Adjusted Estimate	Efficiency Value	Comments
66.6	**Tucson Drive**	WR	10	1,422	$1,783,000	$1,254 Per Severity Point	New project added in 2000 Address after December 2002

Scope

This project was undertaken in connection with the settlement of an enforcement action under the Clean Water Act, United States et al. v. Lexington-Fayette Urban County Government, brought on behalf of the U.S. Environmental Protection Agency. This project is a Supplemental Environmental Project ("SEP") to be funded by LFUCG as part of the Consent Decree entered on January 3, 2011 styled United States & Commonwealth of Kentucky v. Lexington-Fayette Urban County Government, United States District Court for the Eastern District of Kentucky, Civil Action No. 5:06-cv-386-KSF (the "Consent Decree").

The SEP is detailed in Appendix K-2 of the Consent Decree; it discusses the use of a portion of the stormwater management fee for flooding projects, specifically, $30 million over 10 years. It also includes a requirement to evaluate the priority list methodology. GRW's scope of work is:

(1) identify near-term flood relief or elimination actions that result in at least $30 million in capital flood mitigation projects;

(2) evaluation of the priority list methodology; and

(3) develop a Master Planning Work Plan to guide the development of watershed based master plans for stormwater capital improvements.

The deliverables for item (1) of the scope of work are preliminary engineering reports for the highest ranking projects listed on the Stormwater Priority Projects Master list. Tucson Drive is number eleven on the list. This preliminary engineering report includes a description of the flooding problem, documentation of resident's concerns (gathered from questionnaires and meetings), viable mitigation alternatives, identification of pitfalls such as easement acquisition, and estimated costs for final design, easement acquisition, and construction.

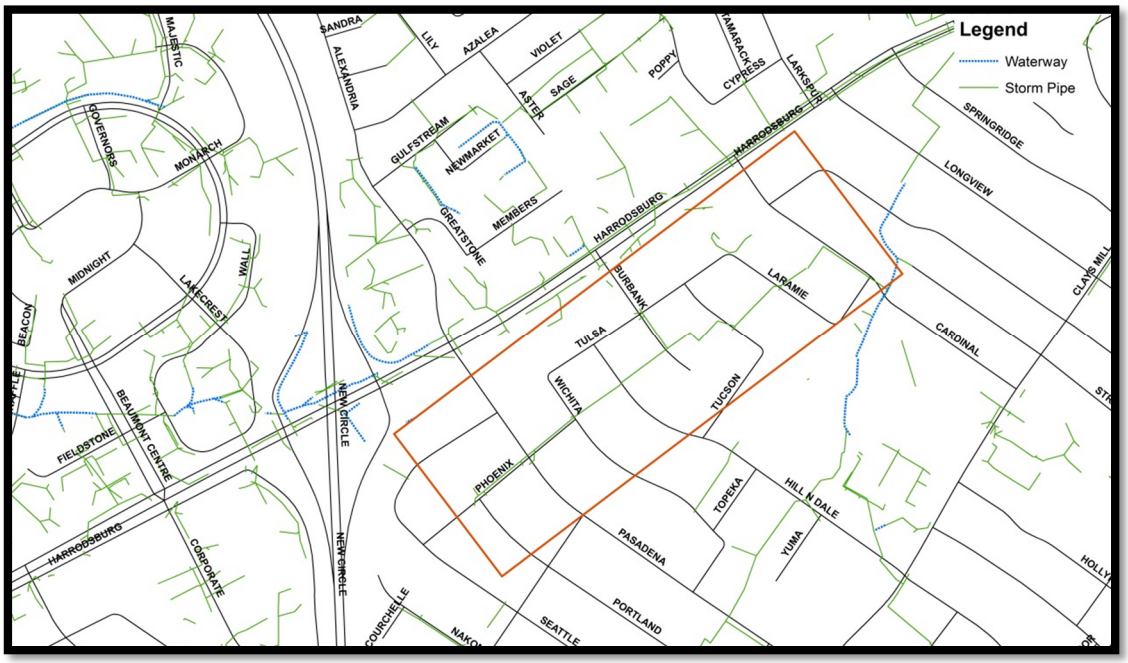
LFUCG has chosen the 25-year, 24-hour storm as the design storm for determining flooding problems and flood mitigation projects.

General Location

The project area is located in Southwestern Lexington. The Tucson Drive project area is located East of the New Circle Road and Harrodsburg Road intersection and West of Southland Park and

Clays Mill Elementary School.

The project area is entirely within Council District 10. It is within the Wolf Run watershed and is part of Southland Park Neighborhood Association.



Background

In 2000, the LFUCG Division of Engineering received inquiries regarding stormwater flooding in the Tucson Drive area. The LFUCG Division of Engineering sent questionnaires to several residences in the Tucson Drive neighborhood to determine the cause and severity of the flooding. In 2012 questionnaires were sent by GRW to residents in the Tucson Drive neighborhood area. These questionnaires were received as early as October 2012. The questionnaires can be found in Appendix B.

2. PROJECT LOCATION

Study Boundary

The extent of the detailed study area generally follows the storm sewer that begins at the intersection of Phoenix Road and Portland Drive and carries stormwater to the stream located in Southland Park, Northeast of the intersection of Laramie Drive and Cardinal Lane. The storm sewer intersects eight roadways; Portland Dr., Pasadena Dr., Wichita Dr., Hill N Dale Rd., Burbank Ct., Tucson Dr., Laramie Dr., and Cardinal Ln.. Curb inlets are located on both sides of each street at the storm sewer and roadway intersections except Cardinal Ln., which has no curb inlets

General Topography

The project area includes the Tucson Drive Neighborhood of the Wolf Run Watershed. The drainage area generally slopes to the northeast, from an elevation of about 1014 feet at the intersection of New Circle Road and Seattle Drive to elevation 960 feet at the stream. The drainage area of the detailed study area consists of residential lots.

A topographical map of the area is shown in Exhibit 1.

Project Area Soils

According to the USGS Web Soil Survey, the project area consists primarily of Bluegrass-Maury silt loam, Maury-Bluegrass Silt Loam, and Donerail silt Loam. Bluegrass-Maury and Maury-Bluegrass silt loam are in the hydrologic soil group 'B' and Donerail silt loam is in the hydrologic soil group 'C'.

FEMA Flood Mapping

None of the project is within the mapped FEMA floodplain.

Existing Infrastructure

Existing infrastructure for the study area is shown in Exhibit 2 and includes:

- A 24-inch storm sewer that begins at the intersection of Phoenix Road and Portland Drive, transitions to a 30-inch storm sewer at the intersection of Phoenix Road and Pasadena Drive, and conveys stormwater to the stream located in Southland Park, Northeast of the intersection of Laramie Drive and Cardinal Lane.
- Curb inlets connected to the storm sewer are located on both sides of the street on Phoenix Rd., Pasadena Dr., Wichita Dr., Hill N Dale Rd. Burbank Ct., Tucson Dr., and Laramie Dr.
- Storm inlets connected to the storm sewer are located at Tucson Drive and the intersection of Phoenix Road and Portland Drive.

Drainage Areas

Stormwater from the roofs, driveways, streets, and yard drainage in the Tucson Drive Neighborhood drain into the curb and storm inlets connected to the 24-inch and 30-inch storm sewer.

Exhibit 3 shows the watershed boundary, catchment areas used in the model, the manholes and curb inlets of the existing storm sewer system in the Tucson Drive project area.

3. DATA COLLECTION

Existing Mapping

The area has been mapped by LFUCG Division of Water Quality. Storm structures and storm pipes are included in the LFUCG GIS database. The locations of storm structures (point features) in the database are from a sub-meter horizontal GPS survey that did not include elevation information.

The LFUCG GIS uses a naming convention for storm structures of the form: WR5_625CI, where WR indicates the major watershed, 5 is a subwatershed indicator, 625 is the structure number, and CI indicates that it is a curb inlet. All structures for the Tucson Drive project are in Wolf Run subwatershed 5, so all begin with WR5. Other structure types are HW: headwall; SI: surface inlet; MH: manhole. The naming convention for storm pipes of the form: WR5_625CI_WR5_624CI, where the first storm structure name is the upstream structure of the storm pipe and the second storm structure name is the downstream structure of the storm pipe.

Survey

Integrated Engineering, PLLC completed a survey of the flood prone area on November 1, 2013. Data including storm and sanitary sewer pipe size, material, and inverts, road centerlines, and cross-sections of roads at sag points were collected. The data collected are provided in Appendix A.

Field Reconnaissance

Field reconnaissance was conducted by GRW on November 11, 2013 and November 26, 2013 to verify topography, and get a better understanding of the cause of the street and yard flooding. Integrated Engineering, PLLC also conducted field reconnaissance while collecting survey information.

4. QUESTIONNAIRES

In 2012 questionnaires were sent by GRW to residents in the Tucson Drive neighborhood area. Several residents indicated flooding in their homes and streets. The seven residents that reported home flooding: three reported seepage through basement walls, two reported failed sump pump, and two reported flooding in their crawlspace. Five residents on Tucson Drive and one from Hill N Dale Road reported street flooding on Tucson Drive. The flooding makes Tucson Drive impassable for cars and overflows onto the sidewalks and yards along Tucson Drive. Additionally, one resident reported a storm manhole surcharging in their backyard along Tucson Drive.

Photos provided by the resident at 2221 Tucson Drive are included with the resident's questionnaire response. The photos were taken on August 31, 2013 between 9:51 and 10:15 AM. The photos show extensive flooding in the resident's backyard and Tucson Drive. Rainfall data from the Weather Underground Open Gates Neighborhood weather station, located 1-mile southeast of the Tucson Drive area, measured 2.99 inches of rainfall between 9:00 and 10:00 AM and 5.36 inches for August 31, 2013. Referencing NOAA's Point Precipitation Frequency Estimates from the Lexington Airport, indicate the storm event photographed by the resident was a 1-hour, 100-year (2.87 in) event between 9:00 and 10:00 AM and a 24-hour, 25-year (5.23 in) event for August 31, 2013.

Rainfall data from the USGS LFUCG Building rain gage, located 3-miles northeast of the Tucson Drive area, measured 0.89 inches of rainfall between 9:00 and 10:00 AM and 2.51 inches for August 31, 2013. Indicating the storm event was less than a 1-hour, 1-year (1.17 in) event between 9:00 and 10:00 AM and a 24-hour, 1-year (2.53 in) event for August 31, 2013.

The returned questionnaires from 2012 can be found in Appendix B.

Table 1
2012 Questionnaire Summary

Address	Home Flooding	Street Flooding	Sewage Evidence
679 Hill N Dale	No	No	N/A
682 Hill N Dale	No	No	N/A
686 Hill N Dale	No	No	No
687 Hill N Dale	No	No	N/A
691 Hill N Dale	No	No	N/A
609 Burbank	No	No	No
616 Burbank	No	No	N/A
2220 Tucson	No	Yes	Yes
2221 Tucson	Yes	Yes	No
2230 Tucson	No	Yes	No
2231 Tucson	Yes	Yes	No
2250 Tucson	No	Yes	No

5. HYDROLOGIC AND HYDRAULIC ANALYSIS

Hydrologic Analysis

The flooded area of the neighborhood is localized to the area near the curb inlets and storm sewer system. Due to the size of the watershed, the rational method was used to calculate peak flow through the area. In order to determine the flow of each pipe section and curb inlet, the drainage area was broken up into 24 catchments. For each catchment, a time of concentration, using TR-55, was calculated. That was used to determine the rainfall intensity from the 25-year intensity-duration-frequency (IDF) curve. The 'C' valve was determined using the values in the LFUCG Stormwater Manual. Table 2 shows a summary of the hydrologic parameters used in the Rational Method, as well as the peak runoff of each catchment.

Table 2
Hydrologic Parameters

Catchment	Inlet ID	Area (acres)	'C' Valve	Time of Concentration (min)	Intensity (in/hr)	Peak Flow (cfs)
1	WR5_595CI	3.87	0.43	37	3.26	5.46
2	WR5_591HW	14.20	0.52	37	3.26	24.23
3	WR5_594CI	0.47	0.49	28	3.72	0.86
4	WR5_598MH	0.28	0.52	20	4.46	0.65
5	WR5_599CI	2.31	0.72	16	4.83	8.09
6	WR5_600CI	8.35	0.39	22	3.91	12.83
7	WR5_604CI	0.31	0.66	10	6.25	1.29
8	WR5_605CI	3.38	0.42	22	4.28	6.12
9	WR5_607CI	3.51	0.46	16	4.83	7.86
10	WR5_608CI	0.66	0.48	15	4.92	1.57
11	WR5_606CI	1.86	0.54	10	6.25	6.33
12	WR5_609CI	1.63	0.54	12	5.72	5.07
13	WR5_610CI	5.13	0.41	23	4.18	8.87
14	WR5_611CI	5.52	0.44	22	4.28	10.47
15	WR5_612CI	2.01	0.51	19	4.55	4.70
16	WR5_614CI	2.52	0.56	10	6.25	8.89
17	WR5_615CI	1.77	0.45	20	4.46	3.58
18	WR5_616CI	2.25	0.48	22	4.28	4.66
19	WR5_619CI	2.43	0.40	23	4.18	4.10
20	WR5_618CI	2.38	0.44	22	4.28	4.51
21	WR5_622SI	1.13	0.35	18	4.64	1.85
22	WR5_621CI	2.84	0.45	24	4.09	5.27
23	WR5_624CI	5.80	0.46	33	3.42	9.19
24	WR5_625CI	2.51	0.49	23	4.18	5.19

Hydraulic Analysis

The hydraulic component of the project consists of the storm sewer system that travels along Phoenix Road starting at the intersection of Phoenix Road and Portland Drive and then travels between homes on Hill N Dale Road, Burbank Court, Tucson Drive, Laramie Drive, and Cardinal Lane. Hydraulic capacity of the system was calculated using Manning's Equation. The peak flow was calculated using StormCAD, V8i. The tables below show a summary of the hydraulic parameters and capacity of the system. The peak flows shown in Table 3 are the cumulative peak flows through each pipe. The peak flows shown in Table 4 are the peak flows to each inlet.

Table 3
Pipe Hydraulic Parameters

Pipe ID	Pipe Size (inches)	Manning's 'N'	Slope (%)	Pipe Capacity (cfs)	Peak Flow (cfs)
WR5_623MH_WR5_617MH	24	0.013	0.6	16.66	12.60
WR5_617MH_WR5_613MH	30	0.013	2.7	69.51	20.51
WR5_613MH_WR5_611CI	30	0.013	1.6	55.25	40.07
WR5_611CI_WR5_610CI	30	0.013	1.0	42.00	X
WR5_610CI_WR5_609CI	30	0.013	1.3	47.12	X
WR5_609CI_WR5_605CI	30	0.013	1.0	40.90	X
WR5_605CI_WR5_604CI	30	0.013	4.1	83.54	62.10
WR5_604CI_WR5_603MH	30	0.013	1.6	51.80	X
WR5_603MH_WR5_602MH	30	0.013	0.6	31.59	X
WR5_602MH_WR5_601MH	30	0.013	0.6	31.11	X
WR5_601MH_WR5_598MH	30	0.024	0.4	13.64	X
WR5_598MH_WR5_597MH	30	0.024	0.5	15.10	X
WR5_597MH_WR5_960MH	30	0.024	1.3	25.65	X
WR5_960MH_WR5_596MH	30	0.024	0.7	17.81	X
WR5_596MH_WR5_593MH	30	0.024	-0.01	-8.48	X
WR5_593MH_WR5_592HW	30	0.024	0.6	16.80	X
WR5_592HW_WR5_591HW	OC***	0.013	2.7	290.50	118.12
WR5_591HW_WR5_590MH	30	0.013	1.1	42.45	X
WR5_590MH_STM_MH-A*	30	0.013	1.2	45.79	X
WR5_586HW_STM_MH-A	36	0.015	0.65	71.82**	68.95
STM_MH-A*_WR5_589HW	48" X 48"	0.013	0.8	184.05**	X

*STM MH-A were surveyed by Integrated Engineering, but isn't in LFUCG GIS data and has no structure ID.

**Pipe information based on Integrated Engineering's Autodesk Storm and Sanitary Model for Cardinal Lane.

***Concrete trapezoid open channel

X – Peak flow exceeds pipe capacity. System surcharges and water is lost from system.

Table 4
Inlet Hydraulic Parameters

Catchment Number	Inlet ID	Drainage Area (acres)	Inlet Capacity (cfs)	Inlet Peak Runoff (cfs)
24	WR5_625CI	2.51	1.6	2.97
23	WR5_624CI	5.80	2.3	4.83
22	WR5_621CI	2.84	2.5	5.45
21	WR5_622SI	1.13	1.7	1.11
19	WR5_619CI	2.43	2.5	5.14
20	WR5_618CI	2.38	2.4	5.01
18	WR5_616CI	2.25	1.6	2.77
17	WR5_615CI	1.77	1.8	3.11
16	WR5_614CI	2.52	2.7	7.46
13	WR5_610CI	5.13	2.3	4.22
14	WR5_611CI	5.52	3.0	10.47
15	WR5_612CI	2.01	3.3	15.31
12	WR5_609CI	1.63	2.4	4.95
8	WR5_605CI	3.38	3.0	10.97
7	WR5_604CI	0.31	2.6	8.04
4	WR5_598MH	0.28	0.9	0.65
6	WR5_600CI	8.35	3.4	12.83
5	WR5_599CI	2.31	2.3	8.09
1	WR5_595CI	3.87	2.4	5.46
3	WR5_594CI	0.47	0.7	0.86
11	WR5_606CI	1.86	2.3	5.06
9	WR5_607CI	3.51	2.2	3.90
10	WR5_608CI	0.66	1.1	1.29

* Based on an intensity (in/hr) of 2.32.

A review of Tables 3 and 4 show the inlet and pipe capacity is less than the peak flow. Due to the insufficient capacity, stormwater runoff cannot enter the system. It floods yards and streets making them impassable for cars.

Model Calibration

Due to the small size of the catchment area and storm sewer system associated with this project, a StormCAD model was created to determine pipe and inlet capacities. The model, while not giving specific water surface elevations, showed surcharging pipes, and insufficient capacities similar to what has been reported by residents. The rational method was used to determine peak runoff rates.

Downstream Conditions

The existing downstream flow through pipe, STM_MH-A_WR5_589HW, based on the Cardinal Lane Study by Integrated was a peak flow of 121.41 cfs. The volume of flow to the downstream system will be discussed in further detail in Section 6. The downstream system has not been analyzed. From aerial mapping, it appears there is a potential constriction where the stream crosses Sheridan Drive.

6. ALTERNATIVE ANALYSIS

Evaluation Criteria

The existing conditions include a lack of pipe and inlet capacity. Each of the following alternatives was compared to the existing conditions, and more specifically, the ability of each to improve both the pipe and inlet capacity in order to eliminate stormwater flooding. Surcharging occurs when pipes lack capacity causing stormwater to rise to the ground or road surface at curb inlets or manholes. Ponding occurs when inlets lack capacity causing stormwater to pond on the road surface.

The surcharging at storm structures was eliminated by increasing the pipe sizes to accommodate the flow entering the system for each alternative. Once the alignment is chosen in final design, additional investigation will be required to determine the necessary size and location of curb inlets to meet the inlet peak runoff for each catchment area.

Alternatives that did not eliminate flooding or had excessive construction constraints were removed from consideration. Each viable alternative was evaluated based on cost, effectiveness at eliminating yard and street flooding, and impact of construction on the Tucson Drive residents.

GRW was notified that any alternative that increased the flow downstream of Cardinal Lane was unacceptable. An alternative may be a viable option to solve flooding in the Tucson Drive project area however it is unacceptable due to downstream conditions. The stream below Cardinal Lane flows under Sheridan Drive where the culvert is inadequate to convey the 25 year, 24 hour storm. To eliminate Tucson Drive flooding the number of curb inlets must be increased and the pipe sizes must be increased. To maintain the same peak flow conveyance to Sheridan Drive detention must be provided.

Tables 5 and 6 compare the seven highest surcharging storm structures based on the change in Hydraulic Grade Line and flow for each alternative.

Alternative 1

Alternative 1 would install additional pipes on a new alignment and replace pipes and structures along the existing system. The new storm sewer alignment would intercept and divert all stormwater runoff from Portland Drive to Hill N Dale Road. The new system would begin at inlet WR5_610CI on Hill N Dale and run Southeast along Hill N Dale Road, turn Northeast at Southland Park and run Northeast along Southland Parks Western border, and tie back into the existing system at Cardinal Lane and Laramie Drive.

Alternative 1 was removed from consideration after preliminary investigation revealed two faults with the location of the diversion. The first fault would present obstacles during the construction of the new alignment. The slope of the new alignment would be going down in elevation heading Southeast from WR5_610CI to WR5_471CI. Hill N Dale Road rises in elevation heading Southeast from WR5_610CI. The elevation changes would result in the new alignment being approximately 18-feet below the ground surface elevation of Hill N Dale Road. The second fault involved the amount of flow that could be diverted at Hill N Dale Road. The amount of flow diverted at Hill N Dale Road isn't sufficient, resulting in numerous pipe changes required in the

existing downstream system. These faults eliminated Alternative 1 from consideration and no additional investigation into this alternative was performed.

Alternative 2

Alternative 2 would increase the existing storm sewer pipe sizes in their current location and replace the existing manholes and curb inlets. Increasing the pipe capacity would eliminate surcharging during the design storm. Replacing the existing curb inlets would increase the inlet capacity resulting in more water getting into the pipes, less water bypassing the curb inlets into the streets and yards and accommodate the larger pipes replacing the existing storm sewer pipes. The manholes would have to be replaced to accommodate the larger pipes replacing the existing storm sewer pipes. The new pipes and storm structures will begin near the end of the existing system at the intersection of Cardinal Lane and Laramie Drive (STM MH-A) and continue through the existing system until the intersection of Phoenix Road and Pasadena Drive (WR5_617MH). See Exhibit 4.

The new pipes will include:

- 1164 LF of 54" RCP/HDPE to replace the storm sewer from STM MH-A to WR5_960MH, connecting to
- 819 LF of 48" RCP/HDPE to replace the storm sewer from WR5_960MH to WR5_604CI, connecting to
- 27 LF of 42" RCP/HDPE to replace the storm sewer from WR5_604CI to WR5_605CI, connecting to
- 1246 LF of 36" RCP/HDPE to replace the storm sewer from WR5_605CI to WR5_617MH,
- 4 LF of 30" RCP/HDPE to replace storm sewer across Phoenix Road from WR5_618CI to WR5_617MH,
- 31 LF of 24" RCP/HDPE to replace storm sewer across Phoenix Road from WR5_621CI to existing storm sewer piping,
- 26 LF of 24" RCP/HDPE to replace storm sewer across Phoenix Road from WR5_619CI to WR5_618CI,
- 26 LF of 24" RCP/HDPE to replace storm sewer across Tucson Drive from WR5_599CI to WR5_600CI,
- 9 LF of 24" RCP/HDPE to replace storm sewer across Laramie Drive from WR5_594CI to WR5_593MH, and
- 27 LF of 18" RCP/HDPE to replace storm sewer across Laramie Drive from WR5_595CI to WR5_594CI.

The inlets, headwalls, and manholes will include:

- 4 – 8' Manholes to replace existing manholes on Cardinal Lane (WR5_590MH), Laramie Drive (WR5_593MH and WR5_596MH) and between Laramie Drive and Tucson Drive (WR5_960MH),

- 5 – 6' Manholes to replace existing manholes between Laramie Drive and Tucson Drive (WR5_597MH), on Tucson Drive (WR5_601MH), between Tucson Drive and Burbank Court (WR5_602MH and WR5_603MH), and Phoenix Road (WR5_617MH),

- 1 – Headwall to replace existing headwalls between Cardinal Lane and Laramie Drive (WR5_592HW and WR5_591HW). Headwalls are being removed due to the replacement of the trapezoidal channel to 54" RCP/HDPE piping. The new headwall will allow stormwater runoff received by the existing flume into the new pipe.

- 13 – Curb inlets to replace existing curb inlets on Laramie Drive (WR5_594CI and WR5_595CI), Tucson Drive (WR5_599CI and WR5_600CI), Burbank Court (WR5_604CI and WR5_605CI), Hill N Dale Road (WR5_609CI and WR5_610CI), Wichita Drive (WR5_611CI and WR5_612CI), and Phoenix Road (WR5_619CI, WR5_618CI, and WR5_621CI).

The eighteen temporary construction easements that will be required are located at the following addresses:

- 646 Cardinal Lane, 648 Cardinal Lane, 621 Laramie Drive, 624 Laramie Drive, 628 Laramie Drive, 2240 Tucson Drive, 2250 Tucson Drive, 2231 Tucson Drive, 2221 Tucson Drive, 613 Burbank Court, 620 Burbank Court, 691 Hill N. Dale Road, 687 Hill N. Dale Road, 690 Hill N Dale Road, 694 Hill N Dale Road, 637 Wichita Drive, 635 Wichita Drive, and 638 Wichita Drive.

The opinion of probable cost for Alternative 2 is $1,027,261 for RCP piping and $841,951 for HDPE piping. Details are provided in Appendix C. This alternative increases flow downstream to Sheridan Drive and is not a viable option.

Alternative 3

Alternative 3 would divert all flow upstream of Tucson Drive (WR5_599CI) along a new alignment, increase the pipe sizes of the existing system upstream of Tucson Drive, install new manholes and curb inlets, and replace existing curb inlets and manholes. Diverting the flow and increasing the pipe capacity would allow the stormwater to remain in the pipes without surcharging during the design storm. Replacing the existing curb inlets would increase the inlet capacity resulting in more water getting into the pipes and accommodate the larger pipes replacing the existing storm sewer pipes. Manholes would have to be replaced to accommodate the larger pipes. See Exhibit 5.

The new pipes will include:

- 146 LF of 54" RCP/HDPE to replace the storm sewer from STM MH-A to a proposed manhole at the intersection of Cardinal Lane and Laramie Drive, connecting to

- 1345 LF of 48" RCP/HDPE for a new storm sewer from a proposed manhole at the intersection of Cardinal Lane and Laramie Drive to WR5_599CI, connecting to

- 306 LF of 48" RCP/HDPE to replace the storm sewer from WR5_599CI to WR5_602MH, connecting to

- 313 LF of 42" RCP/HDPE to replace the storm sewer from WR5_602MH to WR5_605CI, connecting to

- 747 LF of 36" RCP/HDPE to replace the storm sewer from WR5_605CI to WR5_617MH,

- 4 LF of 30" RCP/HDPE to replace storm sewer across Phoenix Road from WR5_618CI to WR5_617MH,

- 31 LF of 24" RCP/HDPE to replace storm sewer across Phoenix Road from WR5_621CI to existing storm sewer piping,

- 26 LF of 24" RCP/HDPE to replace storm sewer across Phoenix Road from WR5_619CI to WR5_618CI, and

- 26 LF of 24" RCP/HDPE to replace storm sewer across Tucson Drive from WR5_599CI to WR5_600CI

The inlets and manholes will include:

- 5 – 6' Manholes along the new storm sewer alignment on Cardinal Lane, Laramie Drive (2), Southland Park, and Burbank Court,

- 4 – 6' Manholes to replace existing manholes on Tucson Drive (WR5_601MH), between Tucson Drive and Burbank Court (WR5_602MH and WR5_603MH), and Phoenix Road (WR5_617MH),

- 11 – Curb inlets to replace existing curb inlets on Tucson Drive (WR5_599CI and WR5_600CI), Burbank Court (WR5_604CI and WR5_605CI), Hill N Dale Road (WR5_609CI and WR5_610CI), Wichita Drive (WR5_611CI and WR5_612CI), and Phoenix Road (WR5_619CI, WR5_618CI, and WR5_621CI), and

- 1 – Curb inlet along the new storm sewer alignment on Tucson Drive.

The one permanent easement that will be required is located at the following address:

- 2300 Tucson Drive

The eleven temporary construction easements that will be required are located at the following addresses:

- 2231 Tucson Drive, 2221 Tucson Drive, 613 Burbank Court, 620 Burbank Court, 691 Hill N Dale Road, 687 Hill N Dale Road, 694 Hill N Dale Road, 690 Hill N Dale Road, 637 Wichita Drive, 635 Wichita Drive, and 638 Wichita Drive

The opinion of probable cost for Alternative 3 is $931,436 for RCP piping and $756,905 for HDPE piping. Details are provided in Appendix C. This alternative increases flow downstream to Sheridan Drive and is not a viable option.

Alternative 4

Alternative 4 would split the flow at Tucson Drive (WR5_599CI) with eighty percent of the flow following the same new alignment in Alternative 3 and twenty percent following the existing system. The new alignment would have smaller pipe diameters than in Alternative 3, increase the pipe sizes of the existing upstream system, install new manholes and curb inlets, and replace existing curb inlets and manholes. The alternative would allow twenty percent of the flow to the existing system, utilizing the existing systems maximum flow capacity based on the existing pipe capacity. The eighty-twenty split would attempt to minimize the need for construction between Laramie Drive and Cardinal Lane except to correct an adverse slope between WR5_596MH and WR5_593MH. Alternative 4 will solve the existing systems problems similarly to Alternative 3. See Exhibit 6.

The new pipes will include:

- 146 LF of 54” RCP/HDPE to replace the storm sewer from STM MH-A to a proposed manhole at the intersection of Cardinal Lane and Laramie Drive, connecting to

- 1043 LF of 42” RCP/HDPE for a new storm sewer from a proposed manhole at the intersection of Cardinal Lane and Laramie Drive to a proposed manhole on Tucson Drive, connecting to

- 58 LF of 48” RCP/HDPE for a new storm sewer from a proposed manhole on Tucson Drive to a proposed catch basin on Tucson Drive, connecting to

- 243 LF of 54” RCP/HDPE for a new storm sewer from a proposed catch basin on Tucson Drive to WR5_599CI, connecting to

- 306 LF of 48” RCP/HDPE to replace the storm sewer from WR5_599CI to WR5_602MH, connecting to

- 313 LF of 42” RCP/HDPE to replace the storm sewer from WR5_602MH to WR5_605CI, connecting to

- 1233 LF of 36” RCP/HDPE to replace the storm sewer from WR5_605CI to WR5_617MH,

- 567 LF of 36" RCP/HDPE to replace the storm sewer from a proposed manhole at the intersection of Cardinal Lane and Laramie Drive to WR5_591HW,

- 435 LF of 30" RCP/HDPE to replace storm sewer from WR5_960MH to WR5_592HW,

- 4 LF of 30" RCP/HDPE to replace storm sewer across Phoenix Road from WR5_618CI to WR5_617MH,

- 31 LF of 24" RCP/HDPE to replace storm sewer across Phoenix Road from WR5_621CI to existing storm sewer piping,

- 26 LF of 24" RCP/HDPE to replace storm sewer across Phoenix Road from WR5_619CI to WR5_618CI,

- 26 LF of 24" RCP/HDPE to replace storm sewer across Tucson Drive from WR5_599CI to WR5_600CI, and

- 36 LF of 18" RCP/HDPE to replace storm sewer from WR5_595CI to WR5_593MH

The inlets, headwalls, and manholes will include:

- 5 – 6' Manholes along the new storm sewer alignment on Cardinal Lane, Laramie Drive (2), Southland Park, and Burbank Court,

- 8 – 6' Manholes to replace existing manholes on Cardinal Lane (WR5_590MH), on Tucson Drive (WR5_601MH), between Tucson Drive and Burbank Court (WR5_602MH and WR5_603MH), on Laramie Drive (WR5_593MH and WR5_596MH), between Laramie Drive and Tucson Drive (WR5_960MH), and Phoenix Road (WR5_617MH),

- 1 – Headwall to replace the existing headwall between Cardinal Lane and Laramie Drive (WR5_591HW)

- 13 – Curb inlets to replace existing curb inlets on Laramie Drive (WR5_595CI and WR5_594CI), Tucson Drive (WR5_599CI and WR5_600CI), Burbank Court (WR5_604CI and WR5_605CI), Hill N Dale Road (WR5_609CI and WR5_610CI), Wichita Drive (WR5_611CI and WR5_612CI), and Phoenix Road (WR5_619CI, WR5_618CI, and WR5_621CI), and

- 1 – Curb inlet along the new storm sewer alignment on Tucson Drive.

The one permanent easement that will be required is located at the following address:

- 2300 Tucson Drive

The fifteen temporary construction easements that will be required are located at the following addresses:

- 646 Cardinal Lane, 648 Cardinal Lane, 621 Laramie Drive, 624 Laramie Drive, 2231 Tucson Drive, 2221 Tucson Drive, 613 Burbank Court, 620 Burbank Court, 691 Hill N. Dale Road, 687 Hill N Dale Road, 694 Hill N Dale Road, 690 Hill N Dale Road, 637 Wichita Drive, 635 Wichita Drive, and 638 Wichita Drive.

The opinion of probable cost for Alternative 4 is $1,094,376 for RCP piping and $901,980 for HDPE piping. Details are provided in Appendix C. This alternative increases flow downstream to Sheridan Drive and is not a viable option.

Alternative 5

Alternative 5 would buy all houses along the existing storm sewer between Tucson and Laramie Drive. The area between these two streets is the location of the highest surcharges from the existing conditions model in StormCAD. The questionnaire response from this area reported extension street flooding and confirmed the surging manholes at WR5_601MH and WR5_602MH. There are two (2) homes that resided within the street and yard flooding area.

The opinion of probable cost for Alternative 5 is $1,893,850. Details are provided in Appendix C.

Purchasing and demolishing the two homes will eliminate the possible home flooding; however, it will not mitigate street flooding. Therefore it is not a viable alternative.

Alternative 6

Alternative 6 would construct a detention basin between Burbank Court and Tucson Drive, increase the existing storm sewer pipe sizes in their current location and replace the existing manholes and curb inlets. Increasing the pipe capacity would eliminate surcharging during the design storm. Replacing the existing curb inlets would increase the inlet capacity resulting in more water entering the pipes, less water bypassing the curb inlets into the streets and yards and accommodate the larger pipes replacing the existing storm sewer pipes. The manholes would be replaced to accommodate the larger pipes replacing the existing storm sewer pipes. The new pipes and storm structures will begin near the end of the existing system at the intersection of Cardinal Lane and Laramie Drive (STM MH-A) and continue through the existing system until the intersection of Phoenix Road and Pasadena Drive (WR5_617MH). Properties purchased for the detention basin site would be 617, 613 and 609 Burbank Court and 2221, 2231, 2241 and 2251 Tucson Drive. See Exhibit 7.

The new pipes will include:

- 1574 LF of 36” RCP/HDPE to replace the storm sewer from STM MH-A to WR5_601MH, connecting to

- Two acre detention basin between Burbank Court and Tucson Drive, connecting to

- 1273 LF of 42” RCP/HDPE to replace the storm sewer from WR5_604CI to WR5_617MH,

The inlets, headwalls, and manholes will include:

- 8 – 6' Manholes to replace existing manholes Cardinal Lane (WR5_590MH), Laramie Drive (WR5_593MH and WR5_596MH) between Laramie Drive and Tucson Drive (WR5_597MH and WR5_960MH), on Tucson Drive (WR5_601MH) and Phoenix Road (WR5_617MH),

- 3 – Two headwalls to replace existing headwalls between Cardinal Lane and Laramie Drive (WR5_592HW and WR5_591HW) and two in the detention basin. Headwalls are being removed due to the replacement of the trapezoidal channel to 36" RCP/HDPE piping. The new headwall will allow stormwater runoff received by the existing flume into the new pipe.

- 13 – Curb inlets to replace existing curb inlets on Laramie Drive (WR5_594CI and WR5_595CI), Tucson Drive (WR5_599CI and WR5_600CI), Burbank Court (WR5_604CI and WR5_605CI), Hill N Dale Road (WR5_609CI and WR5_610CI), Wichita Drive (WR5_611CI and WR5_612CI), and Phoenix Road (WR5_619CI, WR5_618CI, and WR5_621CI).

The fifteen temporary construction easements that will be required are located at the following addresses:

- 646 Cardinal Lane, 648 Cardinal Lane, 621 Laramie Drive, 624 Laramie Drive, 628 Laramie Drive, 2240 Tucson Drive, 2250 Tucson Drive, 620 Burbank Court, 691 Hill N. Dale Road, 687 Hill N. Dale Road, 690 Hill N Dale Road, 694 Hill N Dale Road, 637 Wichita Drive, 635 Wichita Drive, and 638 Wichita Drive.

The opinion of probable cost for Alternative 6 is $2,971,398 for RCP piping and $2,863,211 for HDPE piping. Details are provided in Appendix C.

Alternative 7

Alternative 7 would divert all flow upstream of Tucson Drive (WR5_599CI) along a new alignment to a proposed detention basin on the northern ball field in Southland Park, increase the pipe sizes of the existing system upstream of Tucson Drive, install new manholes and curb inlets, and replace existing curb inlets and manholes. Diverting the flow and increasing the pipe capacity would allow the stormwater to remain in the pipes without surcharging during the design storm. Replacing the existing curb inlets would increase the inlet capacity resulting in more water getting into the pipes and accommodate the larger pipes replacing the existing storm sewer pipes. Manholes would be replaced to accommodate the larger pipes. The proposed detention basin would eliminate the ball field and require the acquisition of the property. See Exhibit 8.

The new pipes will include:

- 146 LF of 36" RCP/HDPE to replace the storm sewer from STM MH-A to a proposed manhole at the intersection of Cardinal Lane and Laramie Drive, connecting to

- 399 LF of 30" RCP/HDPE for a new storm sewer from a proposed manhole at the intersection of Cardinal Lane and Laramie Drive to a proposed manhole in Laramie Drive, connecting to

- 72 LF of 30" RCP/HDPE from a proposed manhole in Laramie Drive to a proposed detention basin on park property on northern ball field, connecting to

- 211 LF of 48" RCP/HDPE from a proposed detention basin on park property on northern ball field to a proposed manhole in Tucson Drive, connecting to

- 59 LF of 48" RCP/HDPE from a proposed manhole in Tucson Drive to a proposed curb inlet in Tucson Drive, connecting to

- 238 LF of 48" RCP/HDPE from a proposed curb inlet in Tucson Drive to WR5_598MH, connecting to

- 125 LF of 48" RCP/HDPE from WR5_598MH to WR5_601 MH, connecting to

- 189 LF of 48" RCP/HDPE from WR5_601 MH to WR5_602MH, connecting to

- 303 LF of 42" RCP/HDPE from WR_602MH to WR5_604CI, connecting to

- 1261 LF of 36" RCP/HDPE to from WR5_604CI to WR5_617MH,

- 4 LF of 30" RCP/HDPE to replace storm sewer across Phoenix Road from WR5_618CI to WR5_617MH,

- 33 LF of 24" RCP/HDPE to replace storm sewer across Phoenix Road from WR5_621CI to existing storm sewer piping,

- 29 LF of 24" RCP/HDPE to replace storm sewer across Phoenix Road from WR5_619CI to WR5_618CI, and

- 30 LF of 24" RCP/HDPE to replace storm sewer across Tucson Drive from WR5_599CI to WR5_600CI.

The inlets and manholes will include:

- 3 – 6' Manholes along the new storm sewer alignment on Cardinal Lane, Laramie Drive, Tucson Drive,

- 4 – 6' Manholes to replace existing manholes on Tucson Drive (WR5_601MH), between Tucson Drive and Burbank Court (WR5_602MH and WR5_603MH), and Phoenix Road (WR5_617MH),

- 11 – Curb inlets to replace existing curb inlets on Tucson Drive (WR5_599CI and WR5_600CI), Burbank Court (WR5_604CI and WR5_605CI), Hill N Dale Road

(WR5_609CI and WR5_610CI), Wichita Drive (WR5_611CI and WR5_612CI), and Phoenix Road (WR5_619CI, WR5_618CI, and WR5_621CI), and

- 1 – Curb inlet along the new storm sewer alignment on Tucson Drive.

The one permanent easement that will be required is located at the following address:

- 2300 Tucson Drive

The eleven temporary construction easements that will be required are located at the following addresses:

- 2231 Tucson Drive, 2221 Tucson Drive, 613 Burbank Court, 620 Burbank Court, 691 Hill N Dale Road, 687 Hill N Dale Road, 694 Hill N Dale Road, 690 Hill N Dale Road, 637 Wichita Drive, 635 Wichita Drive, and 638 Wichita Drive

The opinion of probable cost for Alternative 7 is $1,963,351 for RCP piping and $1,827,540 for HDPE piping. Details are provided in Appendix C.

Alternative 8

Alternative 8 would divert all flow upstream of Tucson Drive (WR5_599CI) along a new alignment to a proposed underground detention basin on the northern ball field in Southland Park, increase the pipe sizes of the existing system upstream of Tucson Drive, install new manholes and curb inlets, and replace existing curb inlets and manholes. Diverting the flow and increasing the pipe capacity would allow the stormwater to remain in the pipes without surcharging during the design storm. Replacing the existing curb inlets would increase the inlet capacity resulting in more water getting into the pipes and accommodate the larger pipes replacing the existing storm sewer pipes. Manholes would have to be replaced to accommodate the larger pipes. The proposed underground detention basin would require a permanent easement on the ball field. See Exhibit 9.

The new pipes will include:

- 146 LF of 36” RCP/HDPE to replace the storm sewer from STM MH-A to a proposed manhole at the intersection of Cardinal Lane and Laramie Drive, connecting to

- 399 LF of 30” RCP/HDPE for a new storm sewer from a proposed manhole at the intersection of Cardinal Lane and Laramie Drive to a proposed manhole in Laramie Drive, connecting to

- 105 LF of 30” RCP/HDPE from a proposed manhole in Laramie Drive to a proposed detention basin on park property on northern ball field, connecting to

- 242 LF of 48” RCP/HDPE from a proposed detention basin on park property on northern ball field to a proposed manhole in Tucson Drive, connecting to

- 59 LF of 48” RCP/HDPE from a proposed manhole in Tucson Drive to a proposed curb

inlet in Tucson Drive, connecting to

- 238 LF of 48" RCP/HDPE from a proposed curb inlet in Tucson Drive to WR5_598MH, connecting to
- 125 LF of 48" RCP/HDPE from WR5_598MH to WR5_601 MH, connecting to
- 189 LF of 48" RCP/HDPE from WR5_601 MH to WR5_602MH, connecting to
- 303 LF of 42" RCP/HDPE from WR_602MH to WR5_604CI, connecting to
- 1261 LF of 36" RCP/HDPE to from WR5_604CI to WR5_617MH,
- 4 LF of 30" RCP/HDPE to replace storm sewer across Phoenix Road from WR5_618CI to WR5_617MH,
- 33 LF of 24" RCP/HDPE to replace storm sewer across Phoenix Road from WR5_621CI to existing storm sewer piping,
- 29 LF of 24" RCP/HDPE to replace storm sewer across Phoenix Road from WR5_619CI to WR5_618CI, and
- 30 LF of 24" RCP/HDPE to replace storm sewer across Tucson Drive from WR5_599CI to WR5_600CI.

The inlets and manholes will include:

- 3 – 6' Manholes along the new storm sewer alignment on Cardinal Lane, Laramie Drive, Tucson Drive,
- 4 – 6' Manholes to replace existing manholes on Tucson Drive (WR5_601MH), between Tucson Drive and Burbank Court (WR5_602MH and WR5_603MH), and Phoenix Road (WR5_617MH),
- 11 – Curb inlets to replace existing curb inlets on Tucson Drive (WR5_599CI and WR5_600CI), Burbank Court (WR5_604CI and WR5_605CI), Hill N Dale Road (WR5_609CI and WR5_610CI), Wichita Drive (WR5_611CI and WR5_612CI), and Phoenix Road (WR5_619CI, WR5_618CI, and WR5_621CI), and
- 1 – Curb inlet along the new storm sewer alignment on Tucson Drive.

A permanent easement would be required at the ball park and 2300 Tucson Drive.

The eleven temporary construction easements that will be required are located at the following addresses:

- 2231 Tucson Drive, 2221 Tucson Drive, 613 Burbank Court, 620 Burbank Court, 691 Hill N Dale Road, 687 Hill N Dale Road, 694 Hill N Dale Road, 690 Hill N Dale Road, 637 Wichita Drive, 635 Wichita Drive, and 638 Wichita Drive

The opinion of probable cost for Alternative 8 is $5,353,650 for RCP piping and $5,216,889 for HDPE piping. Details are provided in Appendix C.

Table 5
Alternatives Summary

	Ground Elevation	Existing Condition	ALTERNATIVE 2 Larger Pipes, Current Location	ALTERNATIVE 3 100% Flow Diversion at Tucson Dr.	ALTERNATIVE 4 80%-20% Split Flow at Tucson Dr.
Location		**HGL**	**HGL**	**HGL**	**HGL**
Tucson Dr. WR5_603MH	977.97	981.37	976.99	976.72	974.43
Tucson Dr. WR5_601MH	975.76	987.88	973.74	974.23	976.76
Tucson Dr. WR5_598MH	975.08	1,006.69	972.99	973.44	973.65
Tucson Dr. WR5_960MH	975.39	1,001.68	970.95	970.35	972.03
Laramie Dr. WR5_593MH	972.77	1,006.40	969.72	970.35	970.97
Cardinal Ln. WR5_590MH	969.02	1,008.42	966.97	968.03	968.61
Cardinal Ln. STM MH-A	964.44	964.86	964.36	964.30	964.29
		Pipe Capacity (cfs)	**Flow (cfs)**	**Flow (cfs)**	**Flow (cfs)**
Tucson Dr. WR5_603MH		31.59	72.34	72.37	72.87
Tucson Dr. WR5_601MH		13.64	72.01	72.01	72.52
Tucson Dr. WR5_598MH		15.10	86.62	83.01	65.89/17.44
Tucson Dr. WR5_960MH		18.47	86.25	0.00	17.43
Laramie Dr. WR5_593MH		16.80	91.99	6.21	23.45
Cardinal Ln. WR5_590MH		45.79	113.25	27.92	45.09
Cardinal Ln. STM MH-A[1]		184.05	181.04	178.14	177.99
Storm Structures Surcharging		22	0	0	0
Easements Required		---	0	1	1
Temp. Construction Easements		---	18	11	15
Opinion of Probable Cost (RCP)		---	$1,074,265	$968,088	$1,137,645
Opinion of Probable Cost (HDPE)		---	$881,496	$786,664	$937,490

* Alternatives 2 and 3 eliminated WR5_598MH and replaced it with WR5_594CI in the existing storm sewer system.

*Alternatives 1 and 5 are not viable options and Alternatives 2, 3 and 4 are not viable at this time.

*Hydraulic Grade Line (HGL) – Surcharging occurs at structure when HGL is greater than ground elevation.

[1]Flows for STM MH-A are the flows from the StormCAD Model plus 68.95 cfs from Integrated Engineering's Autodesk Storm and Sanitary Model.

Table 6
Alternatives Summary

	Ground Elevation	Existing Condition	ALTERNATIVE 6 Neighborhood Detention Basin	ALTERNATIVE 7 Park, Detention Basin	ALTERNATIVE 8 Park, Under Ground Detention Basin Park
Location		**HGL**	**HGL**	**HGL**	**HGL**
Tucson Dr. WR5_603MH	977.97	981.37	NA	976.74	976.74
Tucson Dr. WR5_601MH	975.76	987.88	972.60	973.41	9736.41
Tucson Dr. WR5_598MH	975.08	1,006.69	972.56	972.27	972.27
Tucson Dr. WR5_960MH	975.39	1,001.68	971.67	970.36	970.36
Laramie Dr. WR5_593MH	972.77	1,006.40	970.82	970.35	970.35
Cardinal Ln. WR5_590MH	969.02	1,008.42	967.37	968.00	968.00
Cardinal Ln. STM MH-A	964.44	964.86	963.02	963.00	963.00
		Pipe Capacity (cfs)	**Flow (cfs)**	**Flow (cfs)**	**Flow (cfs)**
Tucson Dr. WR5_603MH		31.59	NA	72.37	72.37
Tucson Dr. WR5_601MH		13.64	11	72.01	72.01
Tucson Dr. WR5_598MH		15.10	28.90	83.01	83.01
Tucson Dr. WR5_960MH		18.47	28.50	0.00	0.00
Laramie Dr. WR5_593MH		16.80	32.11	6.21	6.21
Cardinal Ln. WR5_590MH		45.79	53.79	27.92	27.92
Cardinal Ln. STM MH-A[1]		184.05	122.11	121.52	121.52
Storm Structures Surcharging		22	0	0	0
Easements Required			0	1	1
Temp. Construction Easements			15	11	11
Opinion of Probable Cost (RCP)			$2,971,398	$1,963,351	$5,353,650
Opinion of Probable Cost (HDPE)			$2,863,211	$1,827,540	$5,216,889

*Hydraulic Grade Line (HGL) – Surcharging occurs at structure when HGL is greater than ground elevation.

Downstream Conditions

Alternatives 2, 3, and 4 will increase the downstream peak flow through pipe STM_MH-4_WR5_589HW compared to the existing condition determined by Integrated's Cardinal Lane study. The flows for Alternatives 2, 3, and 4 would be 181.04 cfs, 178.14 cfs, and 177.99 cfs. The peak flow to the downstream system would increase between 56.58 and 59.63 cfs.

Any change in volume would be caused by eliminating ponding, which would result in less

infiltration, and result in more volume in the proposed alternatives. There is no way to quantify these potential changes. However, the anticipated increase would be minimal. The potential downstream constriction would be the same as the constriction discussed in Section 5.

Construction Constraints

Based on LFUCG GIS information, a sanitary sewer is present throughout the neighborhood. Integrated Engineering, PLLC conducted a survey on the existing sanitary sewer, collecting manhole locations, pipe sizes, material, and inverts. The data was used to determine any constraints that would occur based on the proposed alternatives. Pipe crossings occur on Laramie Dr., Tucson Dr., Hill N Dale Rd., Wichita Dr., and Phoenix Rd. Based on the surveyed inverts and the proposed profiles, the sanitary sewer is approximately two or more feet below the proposed alternatives at each crossing.

At this time utility depths have not been determined. Columbia Gas, Kentucky American, AT&T, Time Warner Cable, Windstream, and others provide service to the area. All alternatives would be in close proximity of existing homes, and require careful location as part of the final design. All alternatives will require roadway construction work.

Permits

The final required permits will be determined by the selected alternative and its final design. The possible required permits may include: Kentucky Pollution Discharge Elimination System (KPDES) Form F, Notice of Intent (NOI) for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems (SMS4) KPDES General Permit, Notice of Intent (NOI) for coverage of Storm Water Discharges Associated with Construction Activities Under the KPDES Storm Water General Permit KYR100000, and Application for Permit to Construct Across or Along a Stream and/or Water Quality Certification.

7. CONCLUSIONS

Alternatives 2, 3 and 4 solve flooding in the Tucson Drive Project area only, while Alternatives 6, 7 and 8 solve the Tucson Drive flooding and accommodate the lack of downstream capacity. It has not been determined when the downstream capacity problem will be corrected. Until that determination is made it is impossible to determine which alternative is best.

Alternatives 2, 3 and 4 were initially considered to be viable alternatives. Prior to the determination that these alternatives were not acceptable, the opinion of probable cost, schedule, effects on the public and design were analyzed. The discussion of Alternatives 2, 3 and 4 below is contained in this PER as it may be useful in future decisions if downstream conditions change.

GRW has evaluated the flooding in the Tucson Drive area and determined the existing stormwater sewers do not have the capacity to carry the peak runoff from the 25-year storm event and the inlets are unable to capture all of the runoff and convey it into the system.

A hydraulic model was used to analyze each alternative:

- Alternatives 1 and 5 did not solve all flooding problems and dropped from consideration,
- Alternative 2 which replaces the existing storm sewer with a larger system,
- Alternative 3 which diverts one-hundred percent of the flow upstream of Tucson Drive along a new storm sewer system,
- Alternative 4 which splits the flow upstream of Tucson Drive, eighty percent of the flow along a new storm sewer system and twenty percent continuing through existing system
- Alternative 6 installs a detention basin in the neighborhood upstream of Tucson Drive, limiting the discharge to accommodate downstream conditions
- Alternative 7 installs a detention basin in the park on the northern ball field, limiting the discharge to accommodate downstream conditions, and
- Alternative 8 installs an underground detention basin in the park under the northern ball field, limiting the discharge to accommodate downstream conditions.

Alternatives 2, 3, and 4 mitigate yard and street flooding by improving both the inlet and pipe system capacity issues. Alternatives 6, 7, and 8 mitigate yard and street flooding by improving both the inlet and pipe system capacity issues and providing detention to accommodate the downstream conditions.

Alternatives 2, 3, and 4 solve the flooding problems in the Tucson Drive project area but are not acceptable due to current downstream conditions. Alternatives 6, 7 and 8 solve the flooding problems in the Tucson Drive project area and provide detention adequate to address the downstream conditions.

8. REFERENCES

Lexington-Fayette Urban County Government. 2009. Stormwater Manual. *With amendments*.

National Resources Conservation Service. 2013. Web Soil Survey.

US Department of Agriculture. 1996. Urban Hydrology for Small Watersheds. Technical Release 55 (TR-55).

9. EXHIBITS

Exhibit 1

Site Topography

Exhibit 2

Flood Area and Existing Infrastructure

Exhibit 3

Watershed Boundary and Model Catchments

Exhibit 4

Alternative 2: Larger Pipes on Same Alignment

Exhibit 5

Alternative 3: 100% Flow Diversion at Tucson Dr.

Exhibit 6

Alternative 4: 80% - 20% Split at Tucson Dr.

Exhibit 7

Alternative 6: Neighborhood Detention Basin

Exhibit 8

Alternative 7: Part Detention Basin

Exhibit 9

Alternative 8: Part Underground Detention Basin

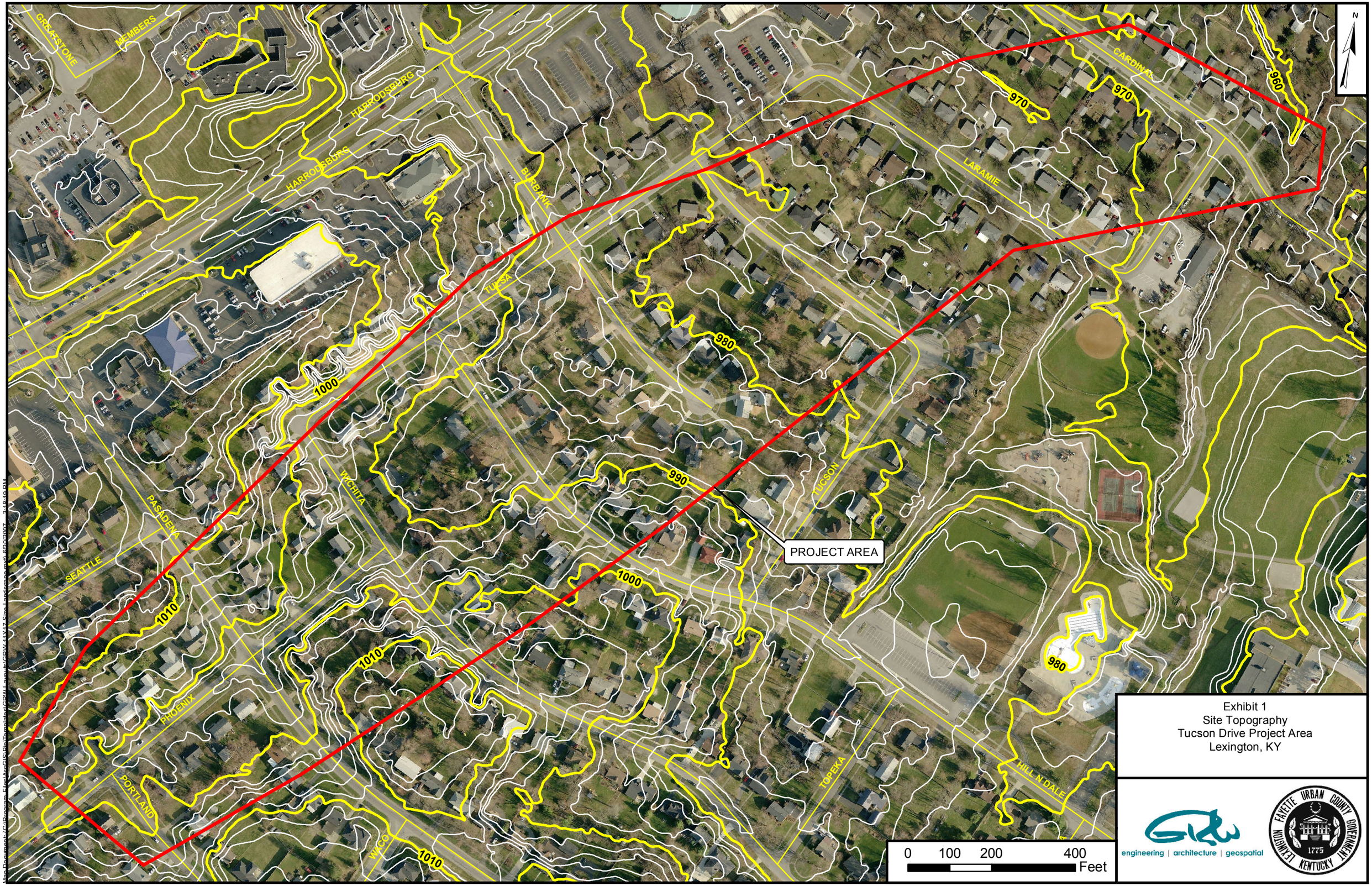
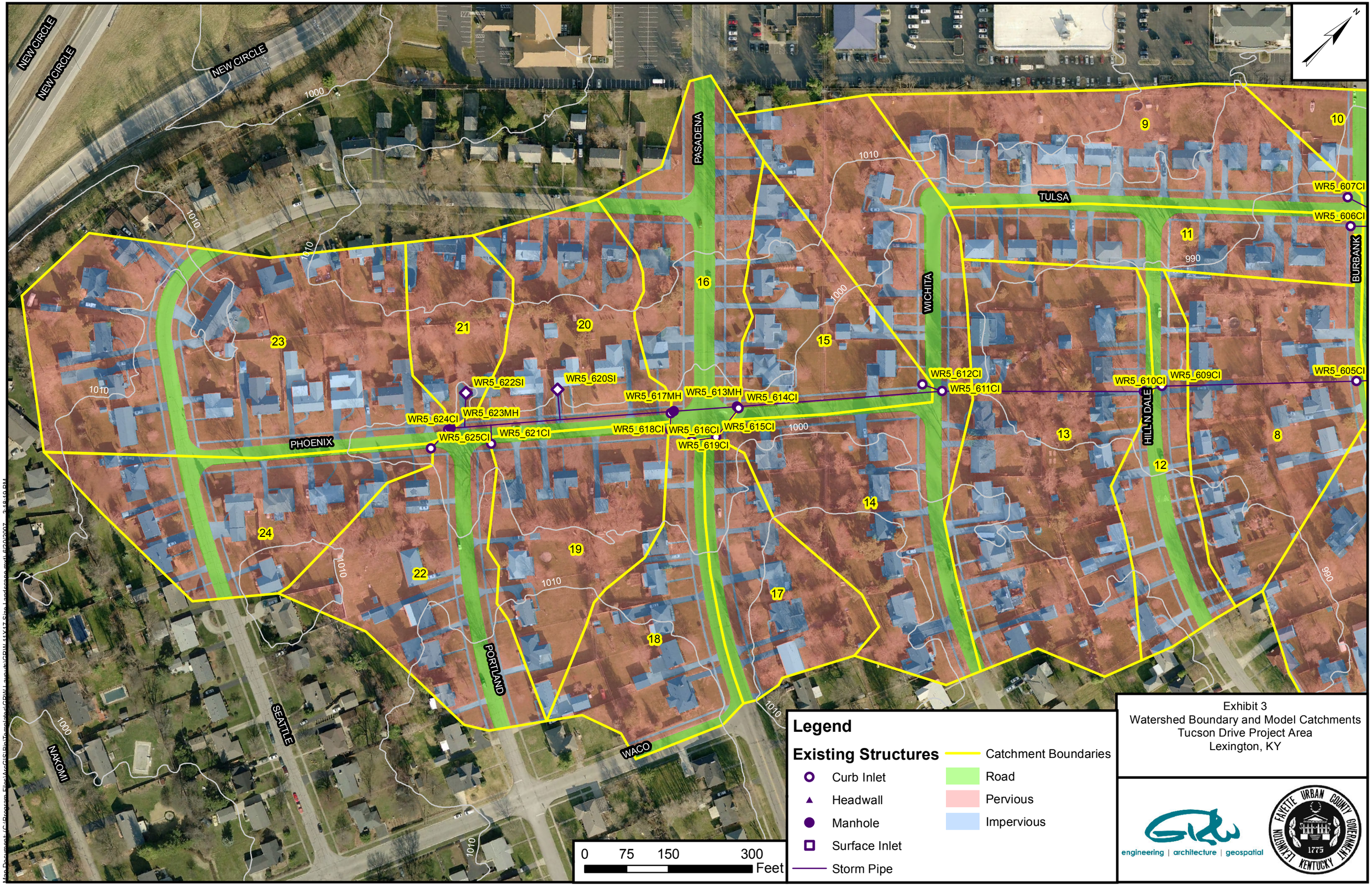


Exhibit 1
Site Topography
Tucson Drive Project Area
Lexington, KY

engineering | architecture | geospatial

LEXINGTON FAYETTE URBAN COUNTY GOVERNMENT
1775
KENTUCKY


N
GREYSTONE
MEMBERS
HARRODSBURG
BURBANK
TULSA
CARDINAL
LARAMIE
ALEXANDRIA
PASADENA
SEATTLE
PHOENIX
PORTLAND
WICHITA
TUCSON
TOPEKA
WACO
15"
18"
24"
30"
12"
48"x48"
0 100 200 400 Feet
Legend
Flood Area
Existing Structures
Curb Inlet
Headwall
Manhole
Surface Inlet
Existing Storm Pipe
Exhibit 2
Flood Area and Existing Infrastructure
Tucson Drive Project Area
Lexington, KY
engineering | architecture | geospatial
LEXINGTON FAYETTE URBAN COUNTY GOVERNMENT
1775
KENTUCKY



Legend

Existing Structures

- Curb Inlet
- Headwall
- Manhole
- Surface Inlet
- Storm Pipe
- Catchment Boundaries
- Road
- Pervious
- Impervious

Exhibit 3
Watershed Boundary and Model Catchments
Tucson Drive Project Area
Lexington, KY

engineering | architecture | geospatial

LEXINGTON FAYETTE URBAN COUNTY GOVERNMENT 1775 KENTUCKY

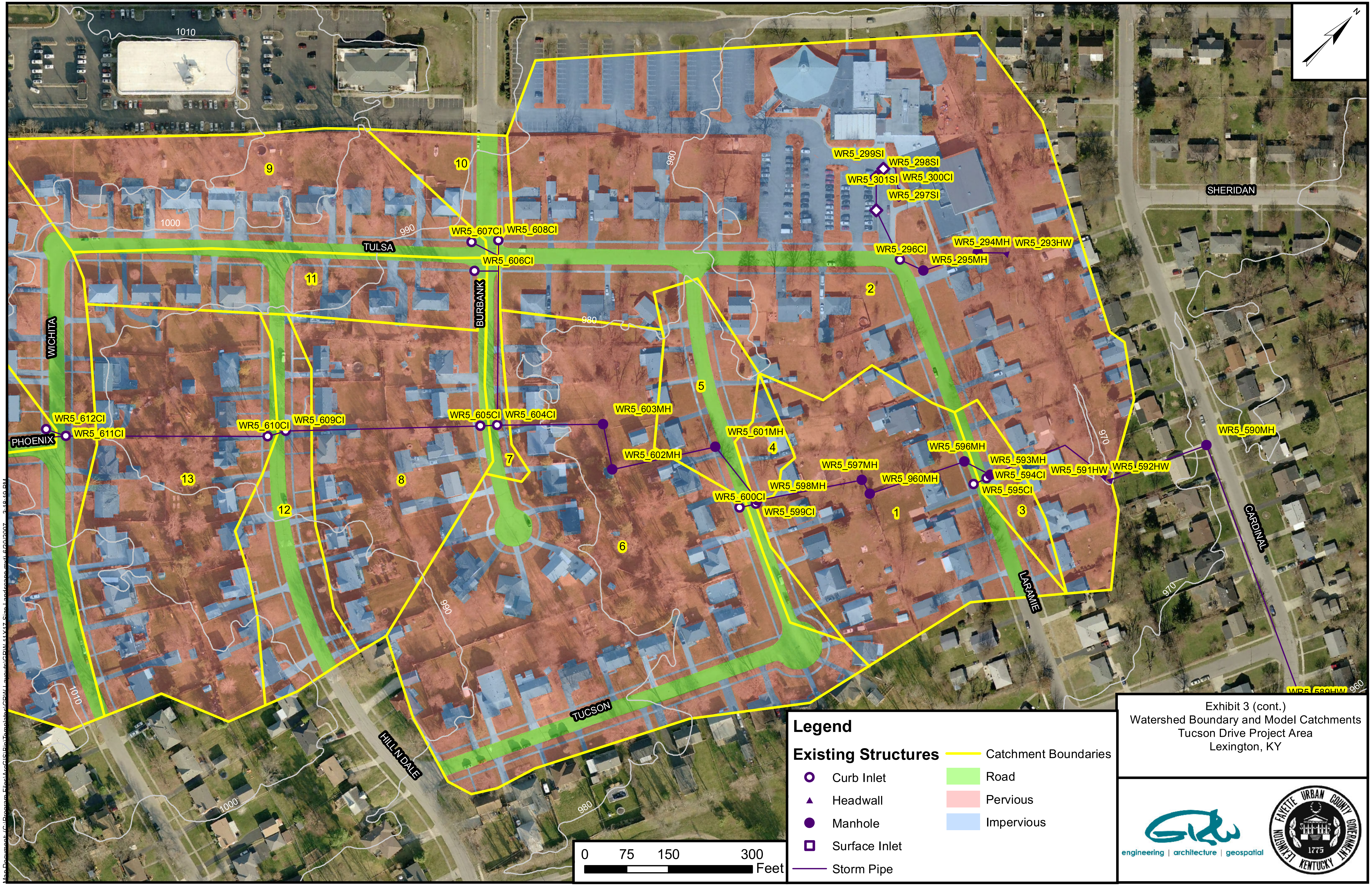


Exhibit 3 (cont.)
Watershed Boundary and Model Catchments
Tucson Drive Project Area
Lexington, KY
Legend
Existing Structures
Curb Inlet
Headwall
Manhole
Surface Inlet
Storm Pipe
Catchment Boundaries
Road
Pervious
Impervious
0 75 150 300
Feet
engineering | architecture | geospatial
LEXINGTON FAYETTE URBAN COUNTY GOVERNMENT KENTUCKY 1775
TULSA
BURBANK
WICHITA
PHOENIX
TUCSON
HILL N DALE
LARAMIE
CARDINAL
SHERIDAN
1
2
3
4
5
6
7
8
9
10
11
12
13
WR5_293HW
WR5_294MH
WR5_295MH
WR5_296CI
WR5_297SI
WR5_298SI
WR5_299SI
WR5_300CI
WR5_301SI
WR5_589HW
WR5_590MH
WR5_591HW
WR5_592HW
WR5_593MH
WR5_594CI
WR5_595CI
WR5_596MH
WR5_597MH
WR5_598MH
WR5_599CI
WR5_600CI
WR5_601MH
WR5_602MH
WR5_603MH
WR5_604CI
WR5_605CI
WR5_606CI
WR5_607CI
WR5_608CI
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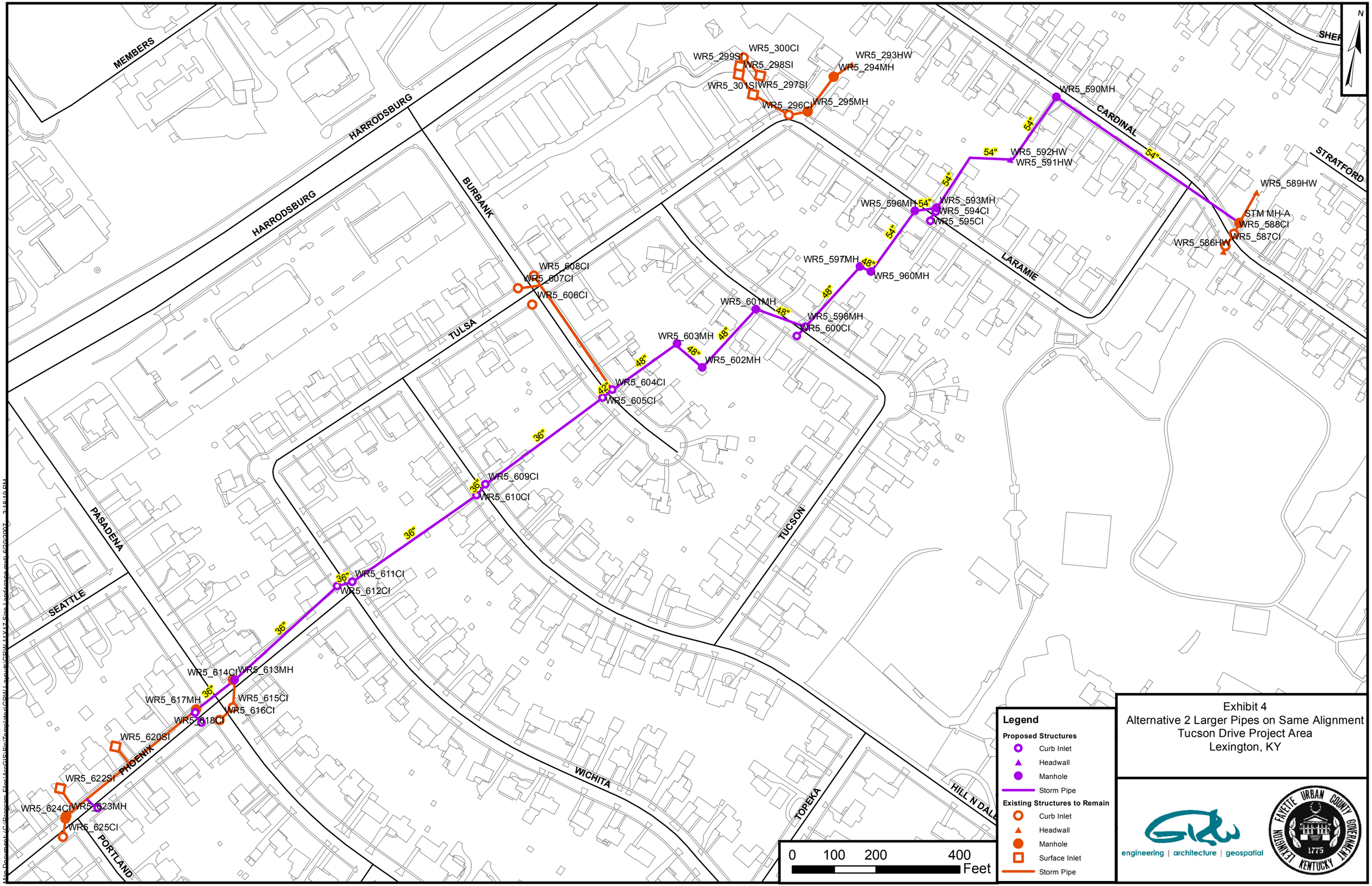
WR5_610CI
WR5_611CI
WR5_612CI
WR5_960MH
1010
1000
990
980
970
960


MEMBERS
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PASADENA
SEATTLE
PHOENIX
PORTLAND
WICHITA
TOPEKA
TUCSON
LARAMIE
CARDINAL
STRATFORD
HILL N DALE
WR5_299SI
WR5_300CI
WR5_298SI
WR5_301SI
WR5_297SI
WR5_296CI
WR5_293HW
WR5_294MH
WR5_295MH
WR5_590MH
WR5_592HW
WR5_591HW
WR5_589HW
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WR5_587CI
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WR5_594CI
WR5_595CI
WR5_597MH
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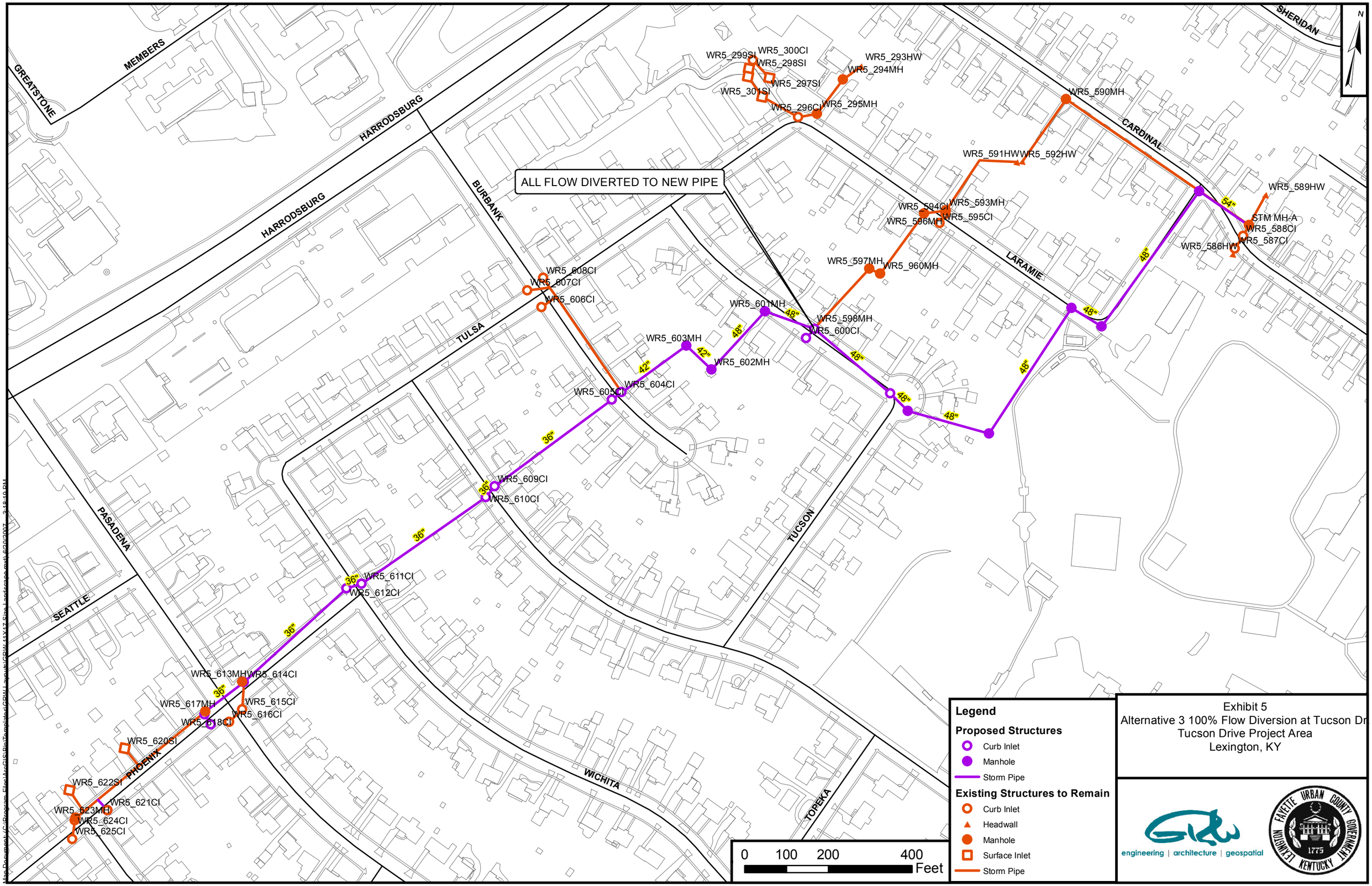
WR5_612CI
WR5_614CI
WR5_613MH
WR5_615CI
WR5_616CI
WR5_617MH
WR5_618CI
WR5_620SI
WR5_622SI
WR5_624CI
WR5_623MH
WR5_625CI
54"
48"
42"
36"
N
0 100 200 400 Feet
Legend
Proposed Structures
Curb Inlet
Headwall
Manhole
Storm Pipe
Existing Structures to Remain
Curb Inlet
Headwall
Manhole
Surface Inlet
Storm Pipe
Exhibit 4
Alternative 2 Larger Pipes on Same Alignment
Tucson Drive Project Area
Lexington, KY
engineering | architecture | geospatial
LEXINGTON KENTUCKY FAYETTE URBAN COUNTY GOVERNMENT 1775


ALL FLOW DIVERTED TO NEW PIPE
WR5_299SI
WR5_300CI
WR5_298SI
WR5_297SI
WR5_301SI
WR5_296CI
WR5_293HW
WR5_294MH
WR5_295MH
WR5_590MH
WR5_591HW
WR5_592HW
WR5_589HW
WR5_594CI
WR5_593MH
WR5_596MH
WR5_595CI
STM MH-A
WR5_588CI
WR5_587CI
WR5_586HW
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WR5_598MH
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WR5_617MH
WR5_618CI
WR5_620SI
WR5_622SI
WR5_621CI
WR5_623MH
WR5_624CI
WR5_625CI
54"
48"
42"
36"
GREATSTONE
MEMBERS
HARRODSBURG
BURBANK
TULSA
PASADENA
SEATTLE
PHOENIX
WICHITA
TOPEKA
TUCSON
CARDINAL
LARAMIE
SHERIDAN
N
0 100 200 400
Feet
Legend
Proposed Structures
Curb Inlet
Manhole
Storm Pipe
Existing Structures to Remain
Curb Inlet
Headwall
Manhole
Surface Inlet
Storm Pipe
Exhibit 5
Alternative 3 100% Flow Diversion at Tucson Dr
Tucson Drive Project Area
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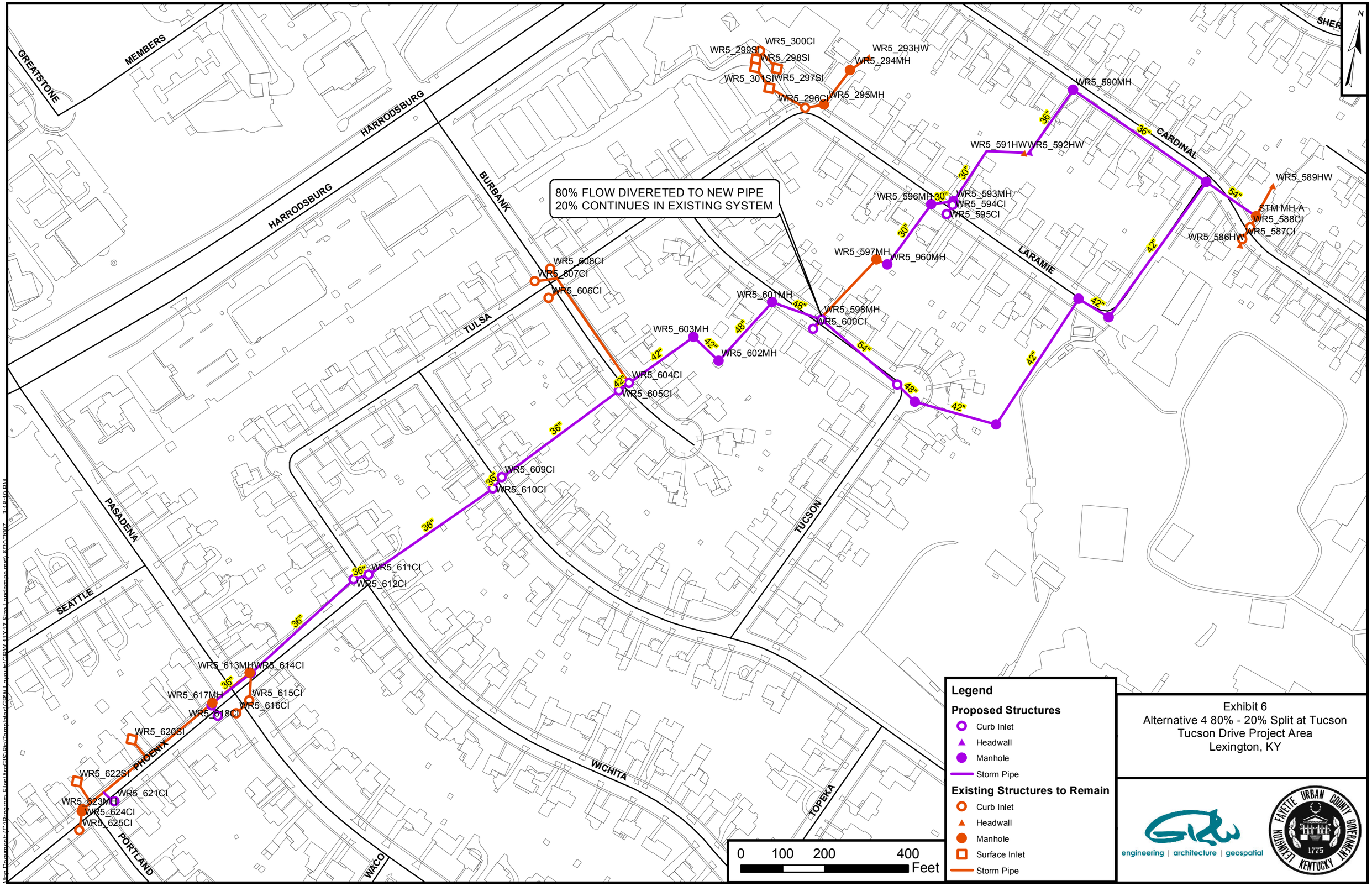
80% FLOW DIVERETED TO NEW PIPE
20% CONTINUES IN EXISTING SYSTEM
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WR5_293HW
WR5_294MH
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WR5_297SI
WR5_296CI
WR5_295MH
WR5_590MH
WR5_591HW
WR5_592HW
WR5_589HW
WR5_596MH
WR5_593MH
WR5_594CI
WR5_595CI
STM MH-A
WR5_588CI
WR5_587CI
WR5_586HW
WR5_597MH
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WR5_608CI
WR5_607CI
WR5_606CI
WR5_601MH
WR5_598MH
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WR5_603MH
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WR5_604CI
WR5_605CI
WR5_609CI
WR5_610CI
WR5_611CI
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WR5_613MH
WR5_614CI
WR5_617MH
WR5_615CI
WR5_616CI
WR5_618CI
WR5_620SI
WR5_622SI
WR5_621CI
WR5_623MH
WR5_624CI
WR5_625CI
GREATSTONE
MEMBERS
HARRODSBURG
BURBANK
TULSA
PASADENA
SEATTLE
PORTLAND
PHOENIX
WICHITA
WACO
TOPEKA
TUCSON
LARAMIE
CARDINAL
36"
30"
42"
48"
54"
N
0 100 200 400 Feet
Legend
Proposed Structures
Curb Inlet
Headwall
Manhole
Storm Pipe
Existing Structures to Remain
Curb Inlet
Headwall
Manhole
Surface Inlet
Storm Pipe
Exhibit 6
Alternative 4 80% - 20% Split at Tucson
Tucson Drive Project Area
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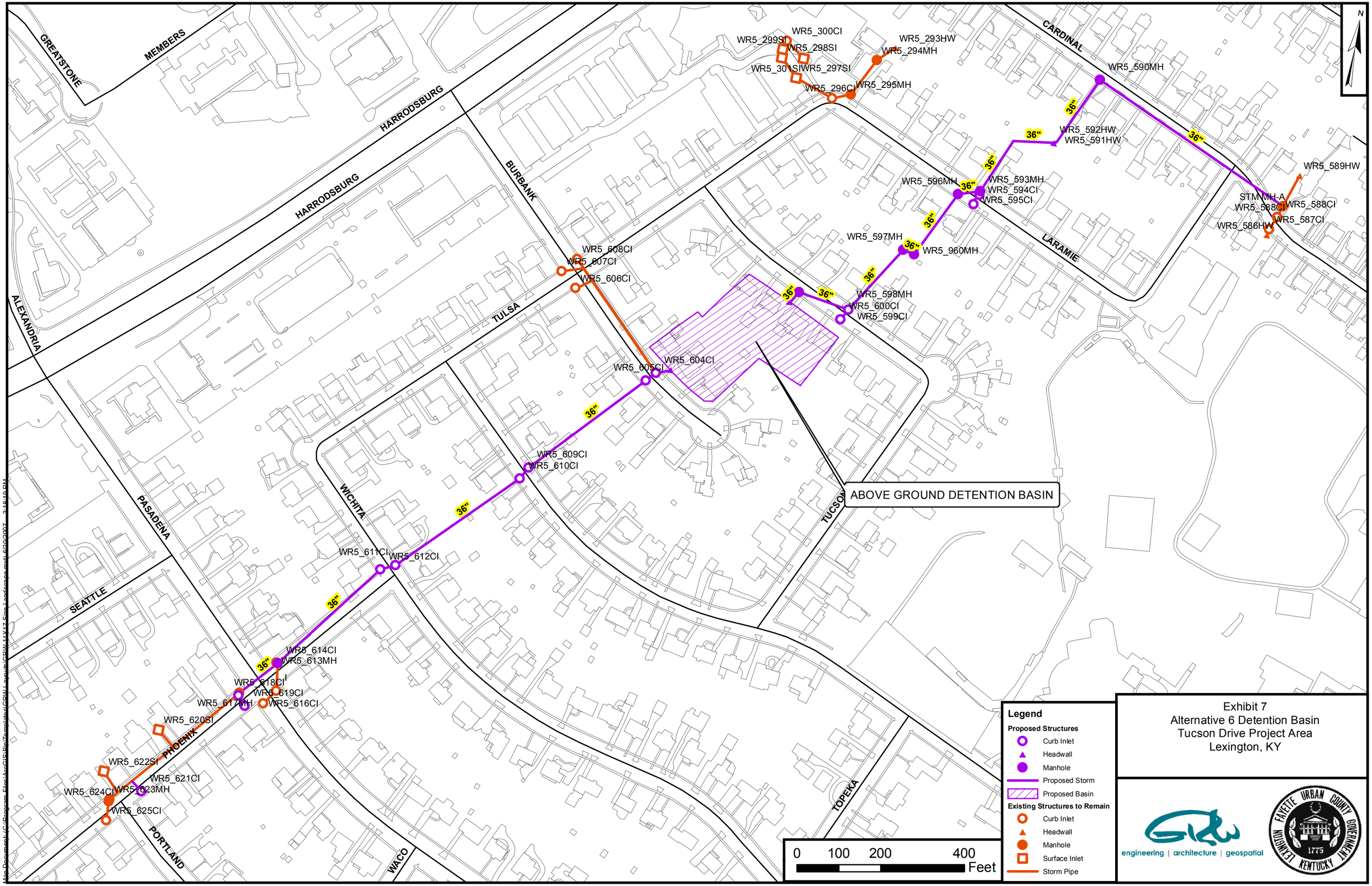
KENTUCKY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MEMBERS
HARRODSBURG
HARRODSBURG
BURBANK
CARDINAL
LARAMIE
TULSA
ALEXANDRIA
PASADENA
WICHITA
SEATTLE
PHOENIX
PORTLAND
WACO
TUCSON
TOPEKA
WR5_299SI
WR5_300CI
WR5_298SI
WR5_293HW
WR5_294MH
WR5_301SI
WR5_297SI
WR5_296CI
WR5_295MH
WR5_590MH
WR5_592HW
WR5_591HW
WR5_589HW
WR5_596MH
WR5_593MH
WR5_594CI
WR5_595CI
STMWH-A
WR5_588CI
WR5_587CI
WR5_586HW
WR5_597MH
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WR5_598MH
WR5_600CI
WR5_599CI
WR5_608CI
WR5_607CI
WR5_606CI
WR5_604CI
WR5_605CI
WR5_609CI
WR5_610CI
WR5_611CI
WR5_612CI
WR5_614CI
WR5_613MH
WR5_618CI
WR5_619CI
WR5_617MH
WR5_616CI
WR5_620SI
WR5_622SI
WR5_621CI
WR5_624CI
WR5_623MH
WR5_625CI
36"
ABOVE GROUND DETENTION BASIN
Legend
Proposed Structures
Curb Inlet
Headwall
Manhole
Proposed Storm
Proposed Basin
Existing Structures to Remain
Curb Inlet
Headwall
Manhole
Surface Inlet
Storm Pipe
0 100 200 400
Feet
Exhibit 7
Alternative 6 Detention Basin
Tucson Drive Project Area
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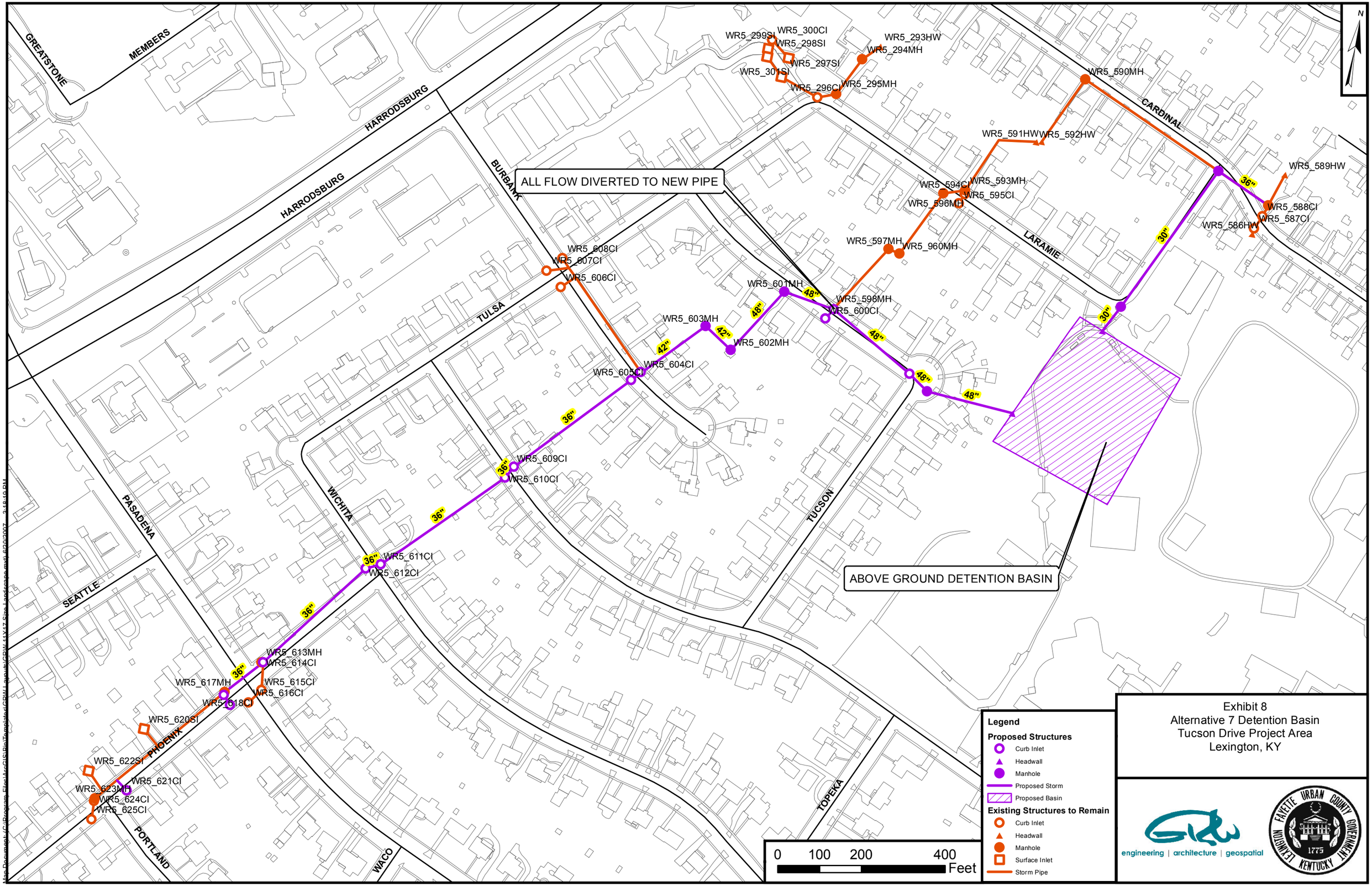
1775
KENTUCKY


GREATSTONE
MEMBERS
HARRODSBURG
HARRODSBURG
BURBANK
TULSA
PASADENA
SEATTLE
PHOENIX
PORTLAND
WACO
WICHITA
TUCSON
TOPEKA
LARAMIE
CARDINAL
ALL FLOW DIVERTED TO NEW PIPE
ABOVE GROUND DETENTION BASIN
WR5_299SI
WR5_300CI
WR5_298SI
WR5_297SI
WR5_301SI
WR5_296CI
WR5_293HW
WR5_294MH
WR5_295MH
WR5_590MH
WR5_591HW
WR5_592HW
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WR5_587CI
WR5_586HW
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WR5_595CI
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WR5_613MH
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WR5_615CI
WR5_616CI
WR5_617MH
WR5_618CI
WR5_620SI
WR5_622SI
WR5_621CI
WR5_623MH
WR5_624CI
WR5_625CI
48"
42"
36"
30"
N
0 100 200 400 Feet
Legend
Proposed Structures
Curb Inlet
Headwall
Manhole
Proposed Storm
Proposed Basin
Existing Structures to Remain
Curb Inlet
Headwall
Manhole
Surface Inlet
Storm Pipe
Exhibit 8
Alternative 7 Detention Basin
Tucson Drive Project Area
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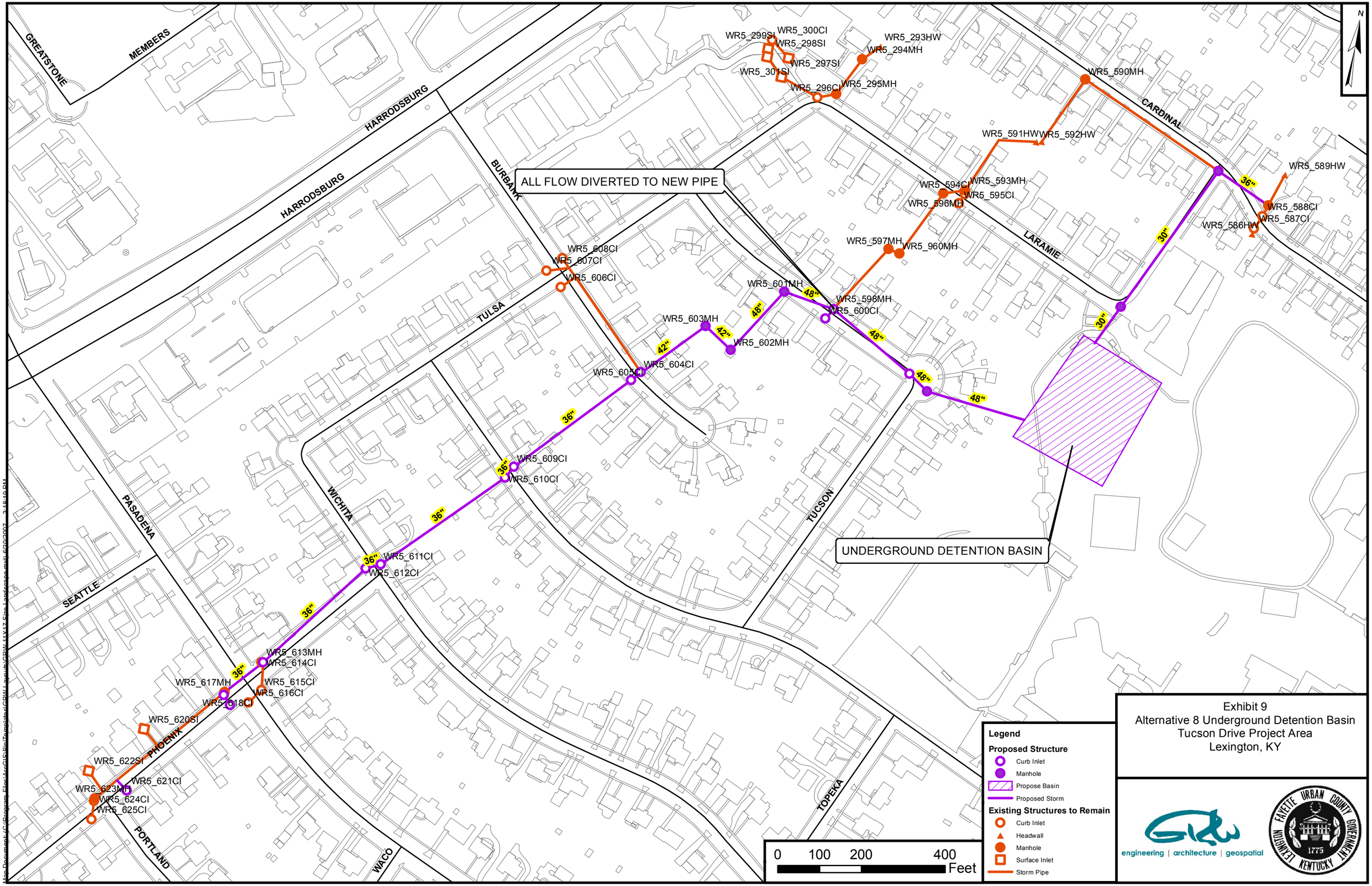
GREATSTONE
MEMBERS
HARRODSBURG
HARRODSBURG
BURBANK
TULSA
PASADENA
SEATTLE
WICHITA
PHOENIX
PORTLAND
WACO
TUCSON
TOPEKA
CARDINAL
LARAMIE
ALL FLOW DIVERTED TO NEW PIPE
UNDERGROUND DETENTION BASIN
WR5_299SI
WR5_300CI
WR5_298SI
WR5_297SI
WR5_301SI
WR5_296CI
WR5_293HW
WR5_294MH
WR5_295MH
WR5_590MH
WR5_591HW
WR5_592HW
WR5_589HW
WR5_594CI
WR5_593MH
WR5_595CI
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WR5_617MH
WR5_615CI
WR5_616CI
WR5_618CI
WR5_620SI
WR5_622SI
WR5_621CI
WR5_623MH
WR5_624CI
WR5_625CI
36"
42"
48"
30"
0 100 200 400 Feet
Legend
Proposed Structure
Curb Inlet
Manhole
Propose Basin
Proposed Storm
Existing Structures to Remain
Curb Inlet
Headwall
Manhole
Surface Inlet
Storm Pipe
Exhibit 9
Alternative 8 Underground Detention Basin
Tucson Drive Project Area
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1775
KENTUCKY

10. APPENDICES

Appendix A

Survey Data

Appendix B

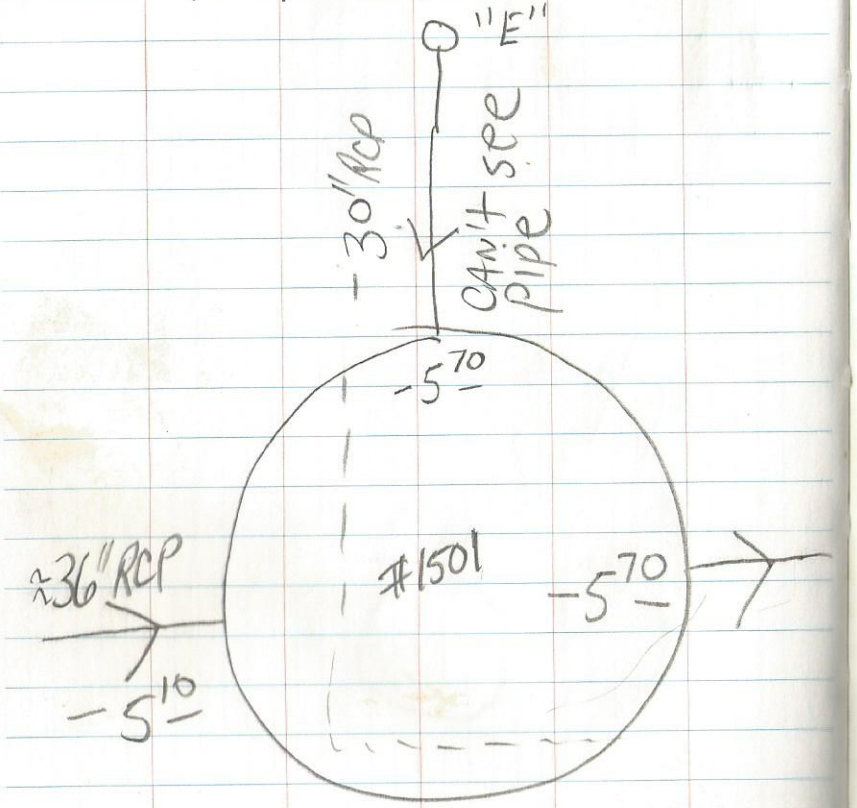
2012 Questionnaires

Appendix C

Preliminary Opinion of Probable Cost

APPENDIX A

Manhole "A"

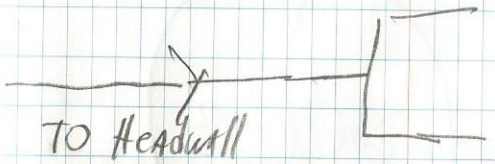


Estes

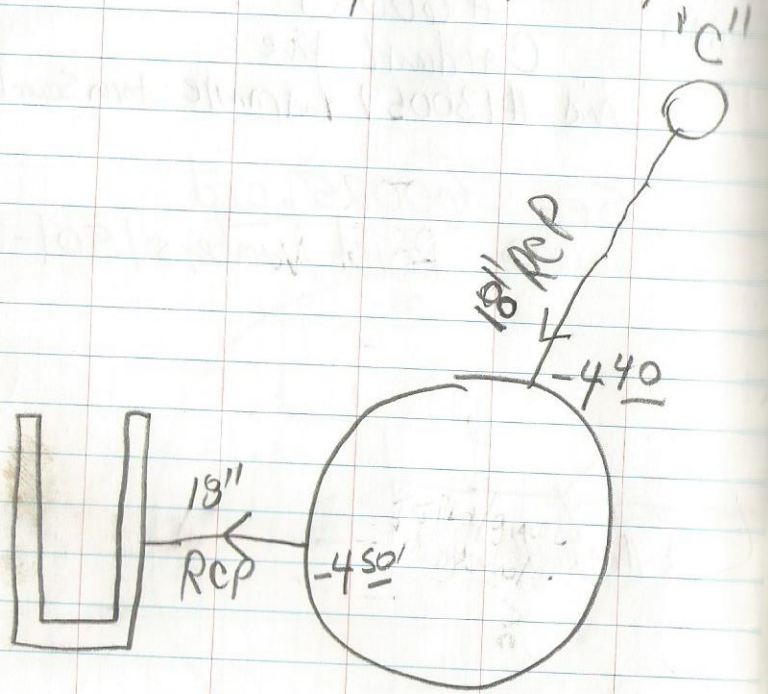
10-21-13 (1)

#60025
Cardinal Ave
And #130057 Laramie Storm Sewer Project

See 60025.crd
Point Numbers 1501-1658



Manhole "B"
(see photo #3024)

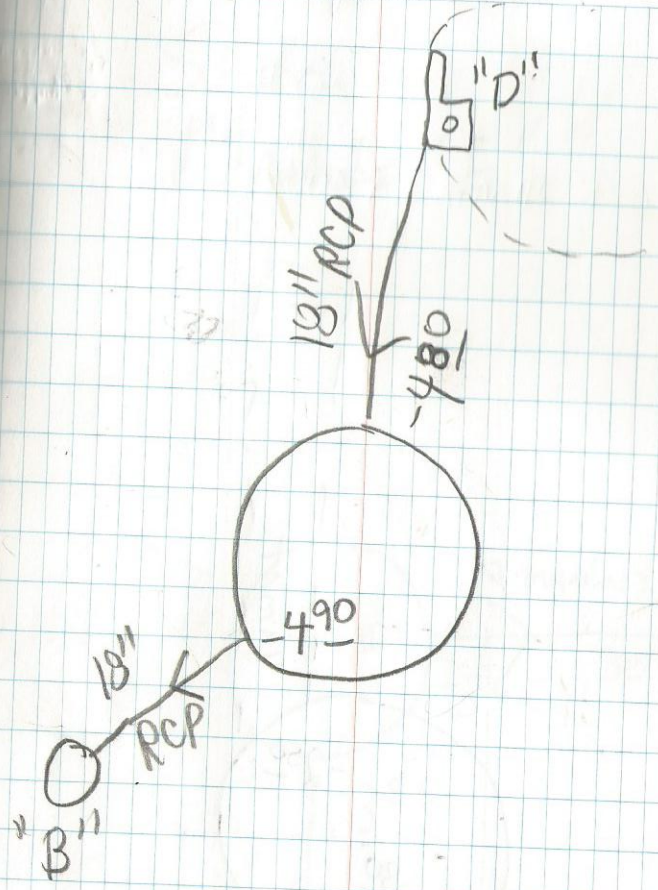


MH - "B"

Estes
10-21-13

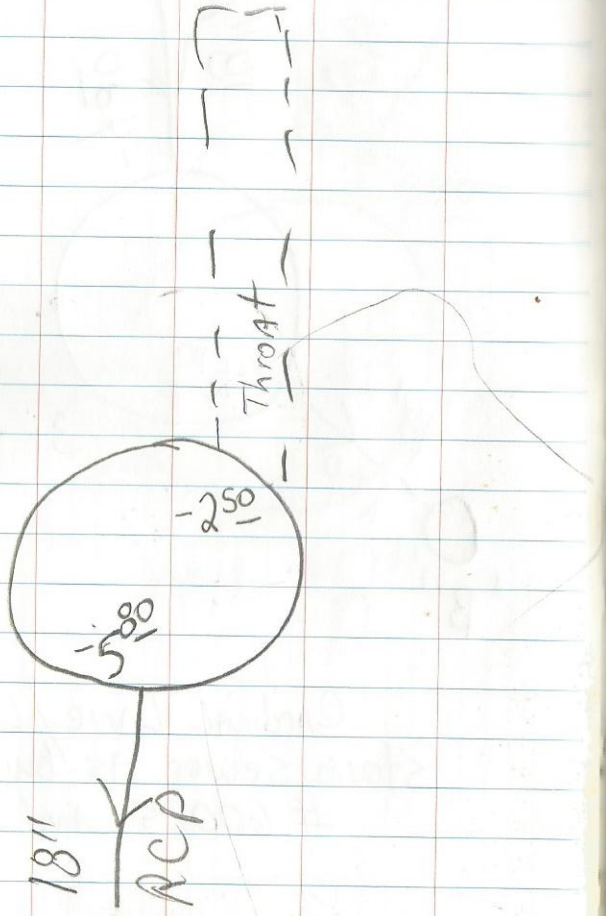
Manhole "C"

(2)



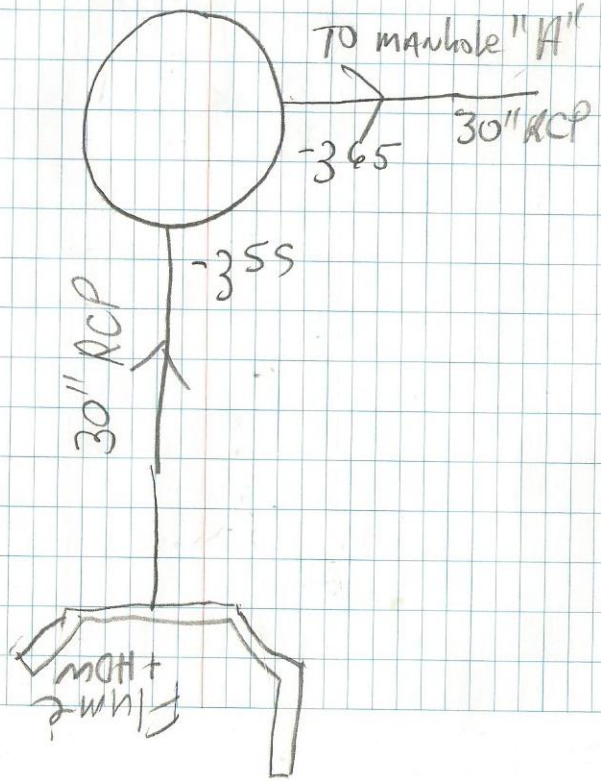
Cardinal Lane / Laramie
storm sewer As-builts.
60025 and # 130057

Manhole/CBI "D"

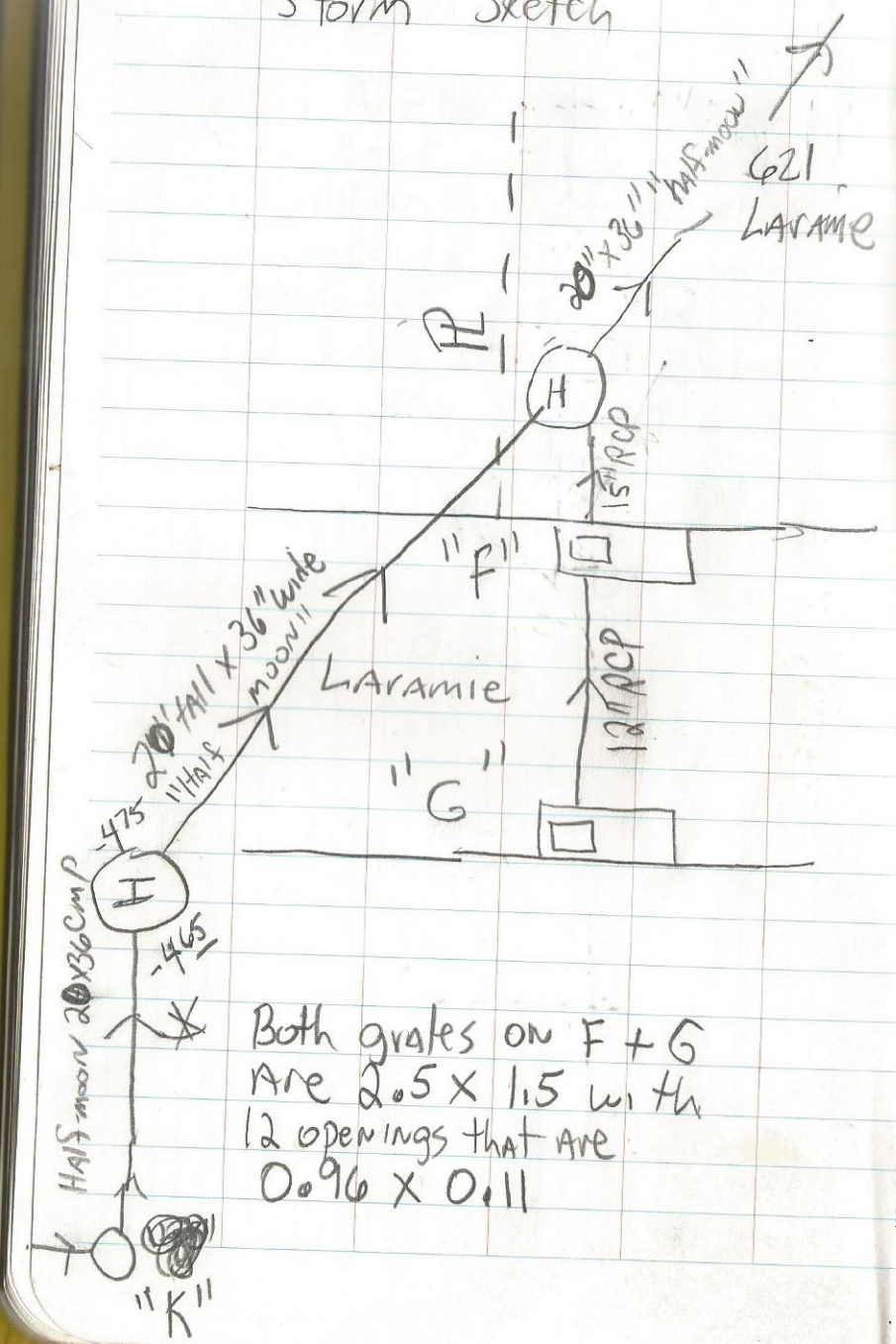


365
355 30"

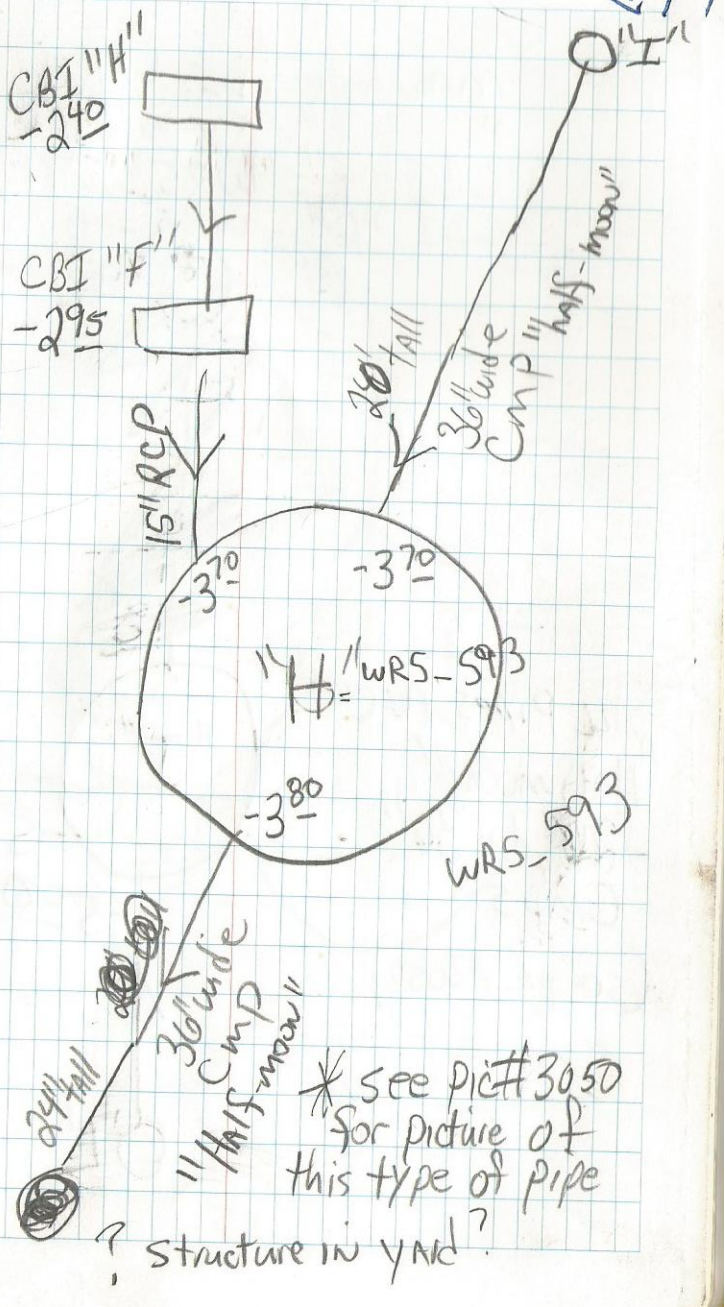
Sketch
Manhole "E"



storm Sketch



Both grates on F + G are 2.5 x 1.5 with 12 openings that are 0.96 x 0.11

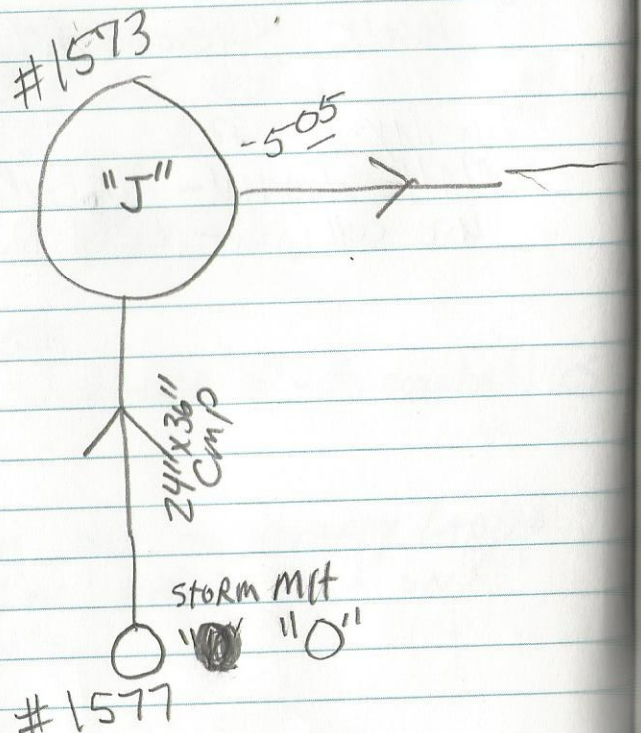


* see pic #3050 for picture of this type of pipe

STM MANhole "J" = WR5_597
storm manhole "K" = WR5_960
CBI "F" = WR5_594
CBI "G" = WR5_595

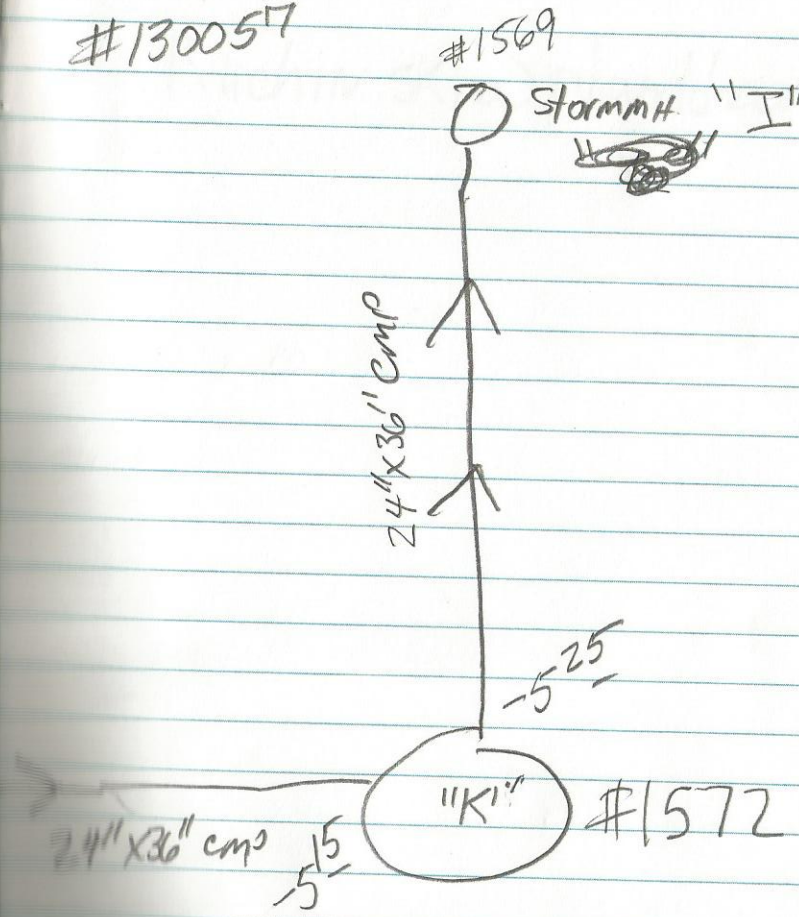
Sketch STORM MANhole "J"

ALL pipes Are "half moon" 24"x36" CMP
(see picture #3050)



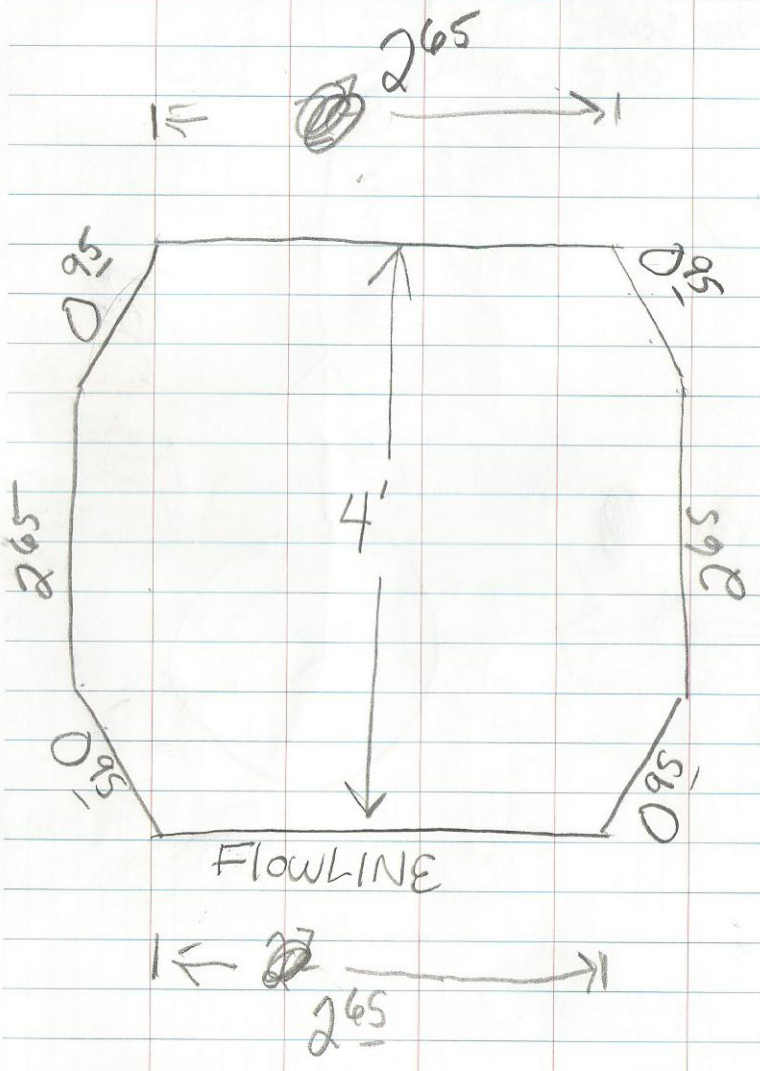
Estes
10-21-13
#130057

(5)



STORM MH "K"

Sketch of Outlet Pipe
@ # 1507



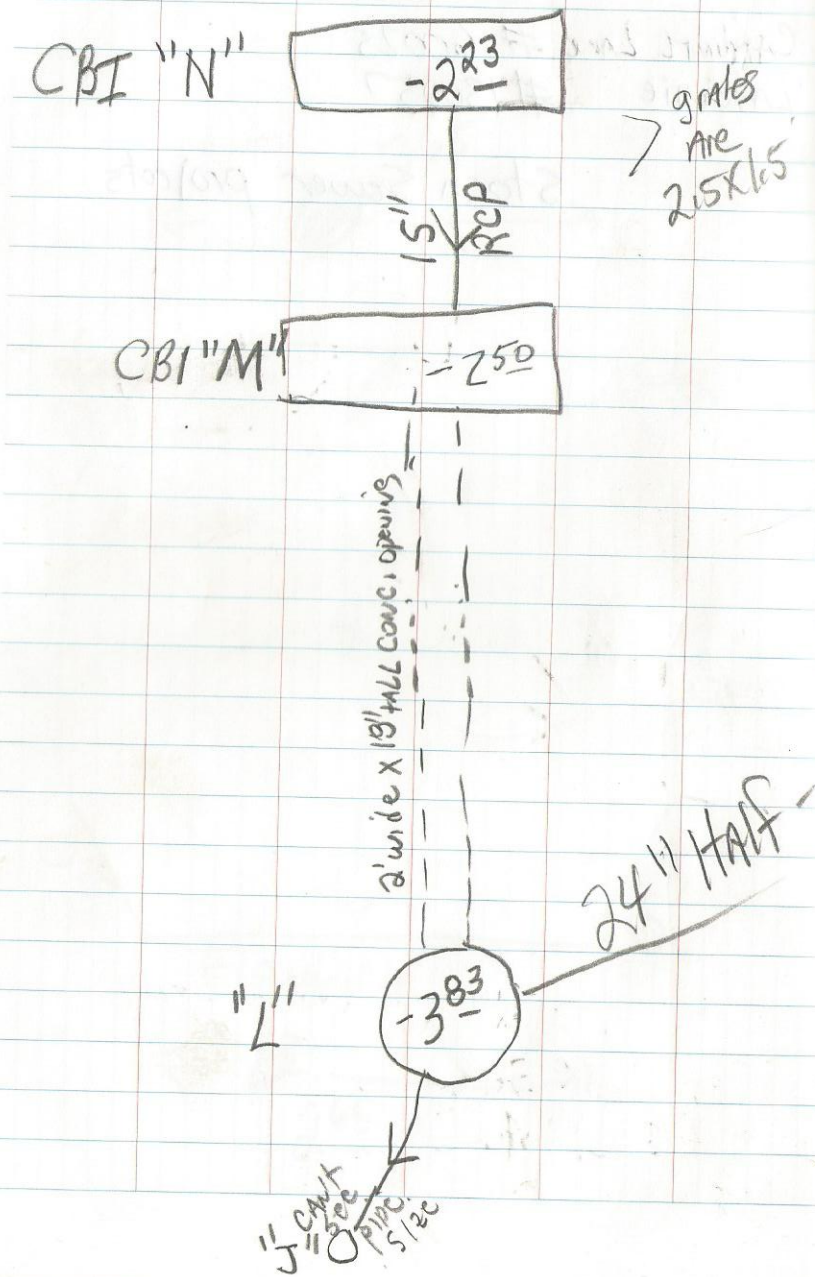
Notes

10-25-13

(6)

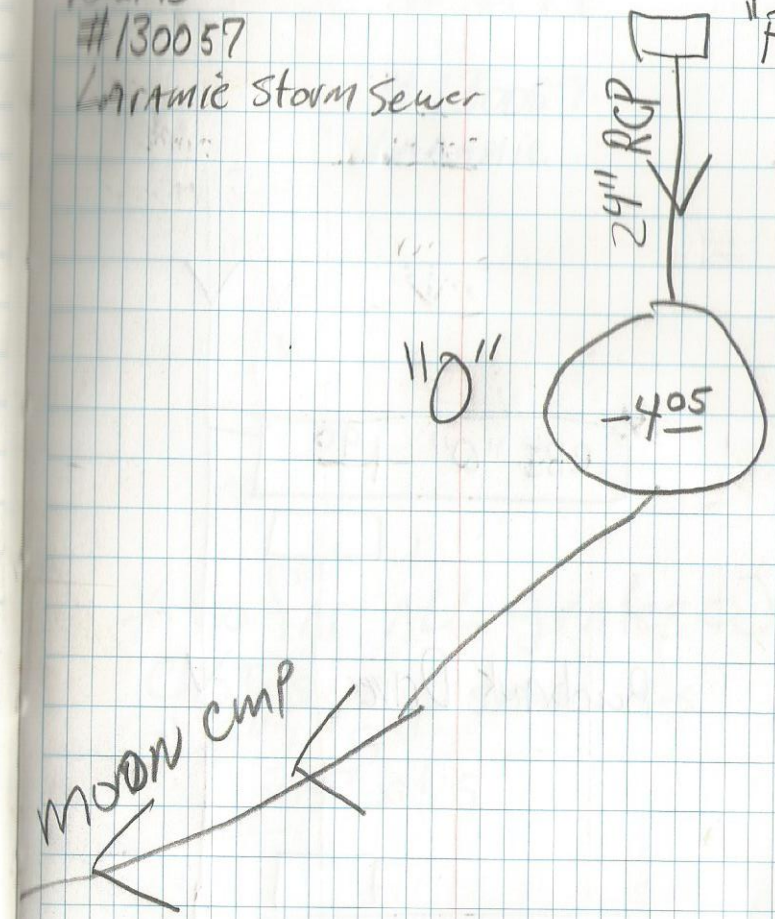
Cardinal Lane # 60025
Laramie # 130057

Storm Sewer projects



Estes
10-21-13
#130057
Laramie Storm Sewer

(7)



* "L" is a 24" diameter grate with 0.10 ft. wide openings (See photo 3025

Delete 8012

Notes

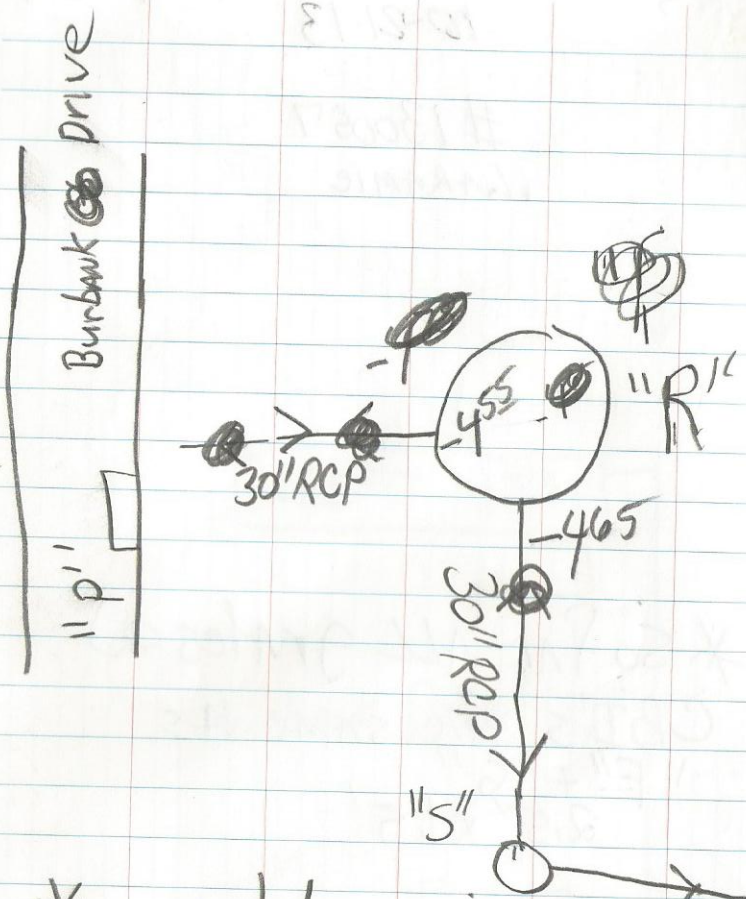
10-21-13

(8)

#130057
LARAMIE

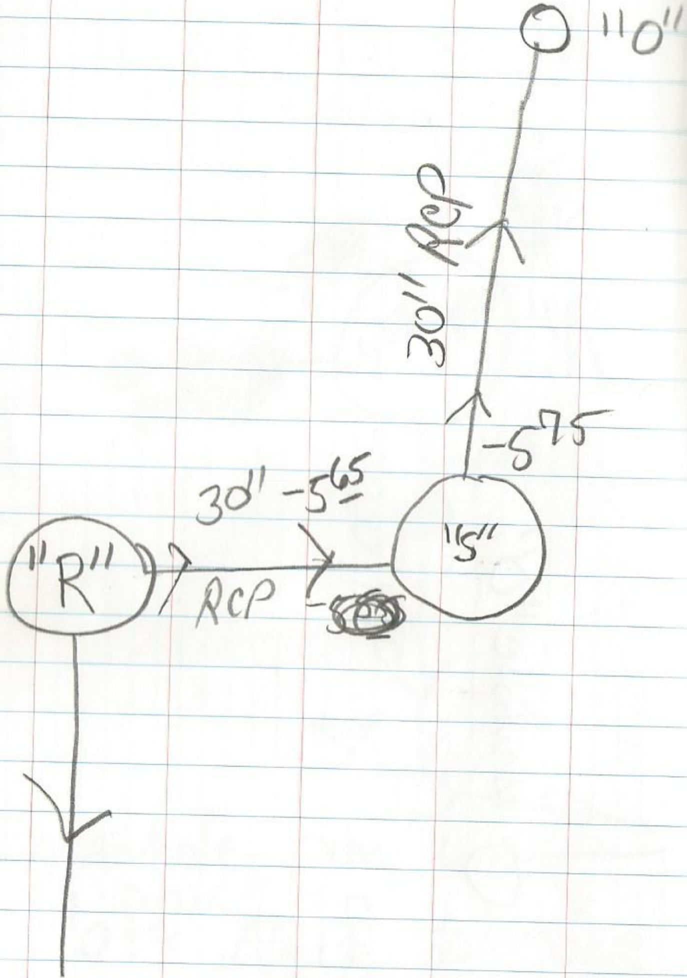
* So far ALL grates @ CBI's are same as "F" + "G" 2.5' x 1.5'

* Looks like "main line" runs right by the end of CBI "P", and "P" connects to main line with 2' tall by 1' wide cut @ back of curb box. Ditto for CBI "Q"



* manhole rim was "off" as if someone was using this manhole as a surface inlet, but found out later that lid was forced off by storm water.

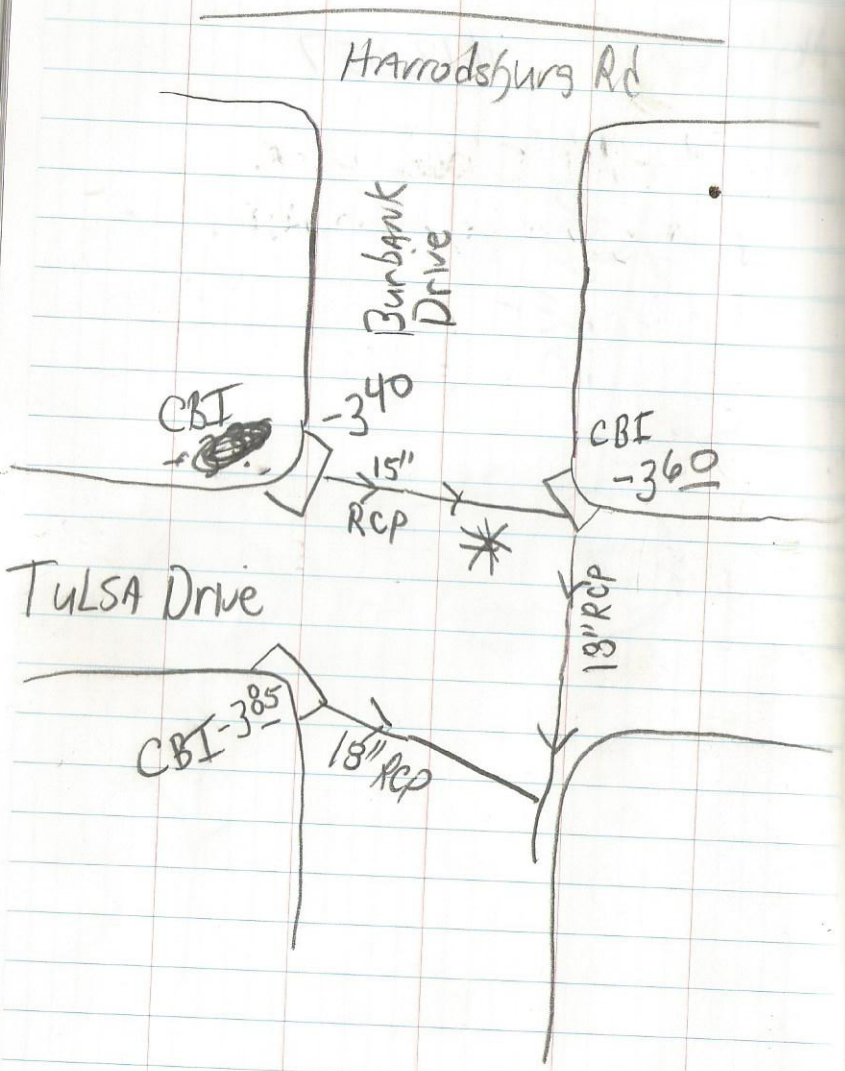
MH "S"



Soles

10-21-13

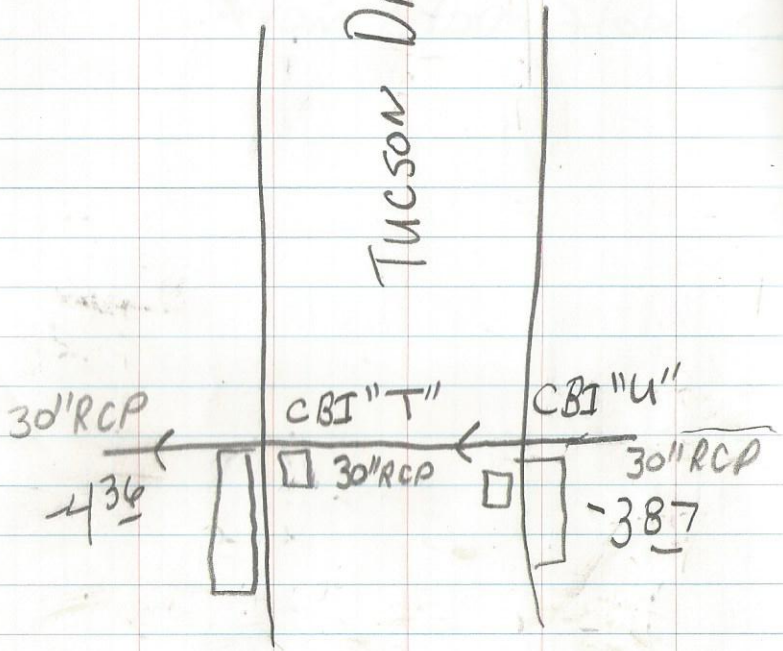
#130057



Notes
#130057 10-21-13 (11)

* Plan shows pipe not joining @ CBI, but while not positive, it looks like it does.

GRATES Are 2.5x1.5'

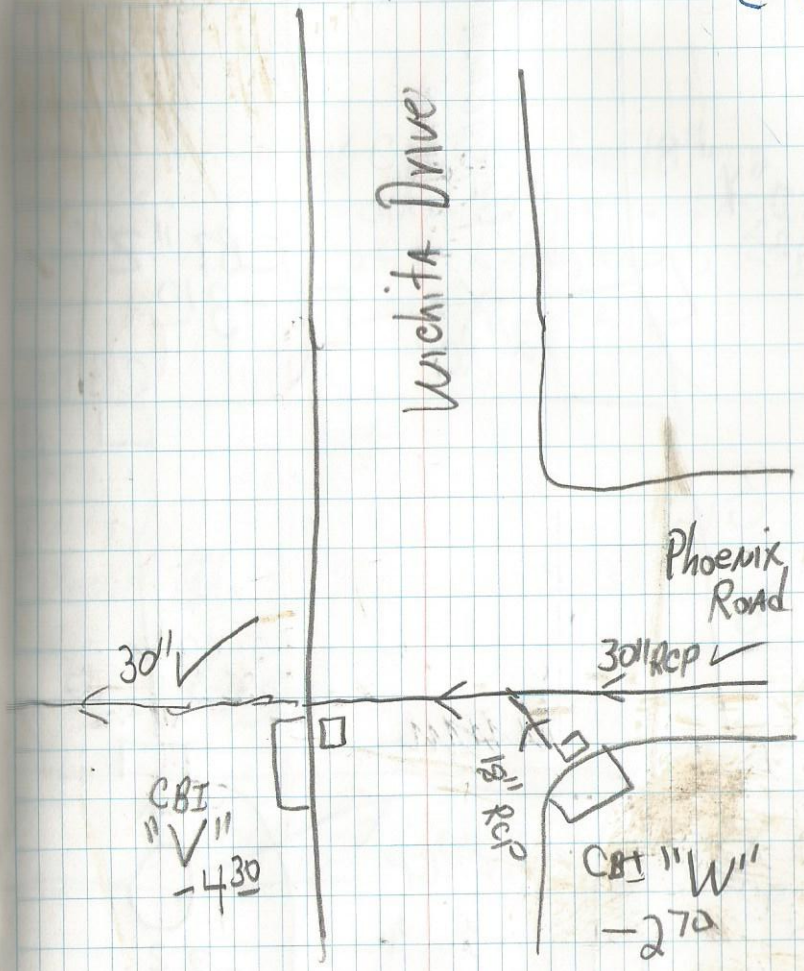


CBI's T, U + V

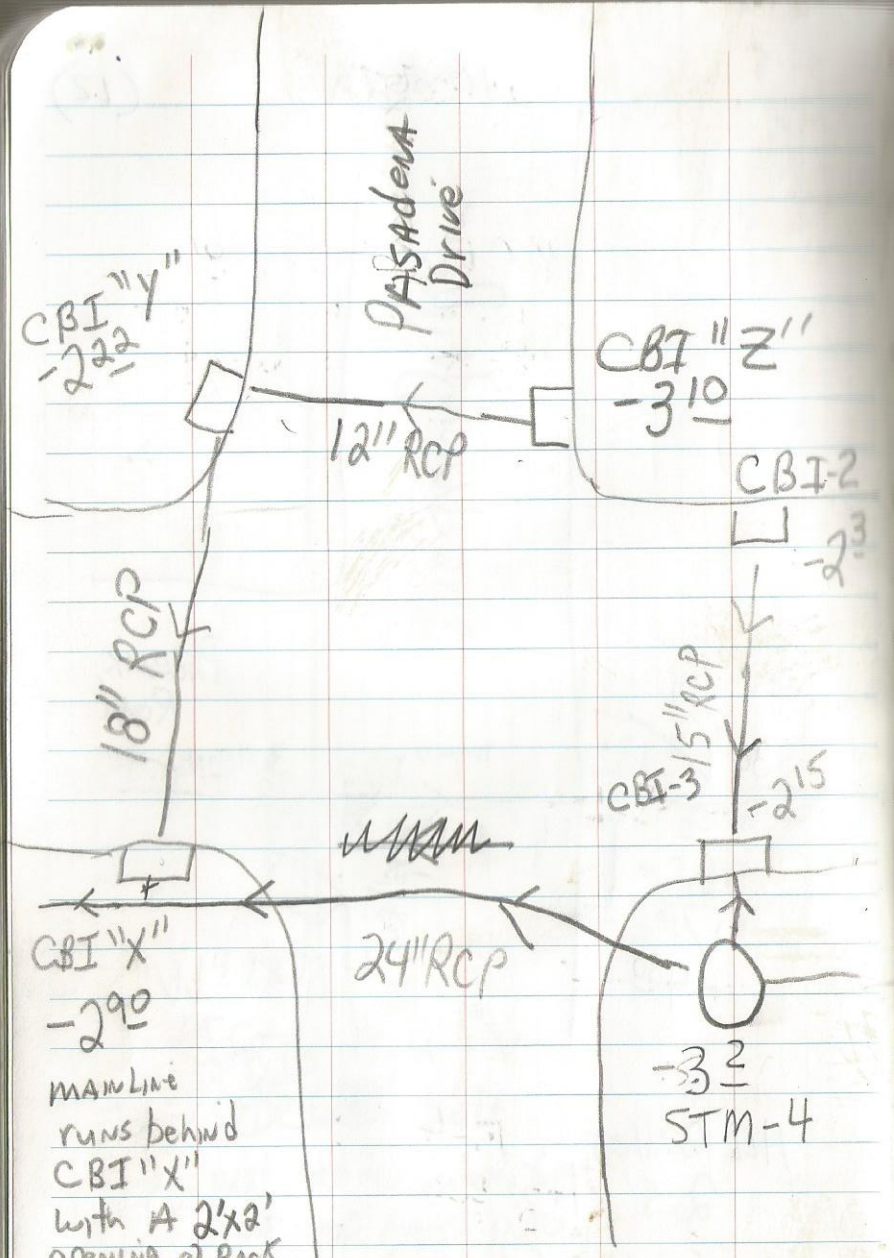
Are ~~Both~~ ~~CBI~~ built

just beside main Line and drop right into said Line (30" RCP)

10-22-13 (12)



ALL Grates 2.5' x 1.5'

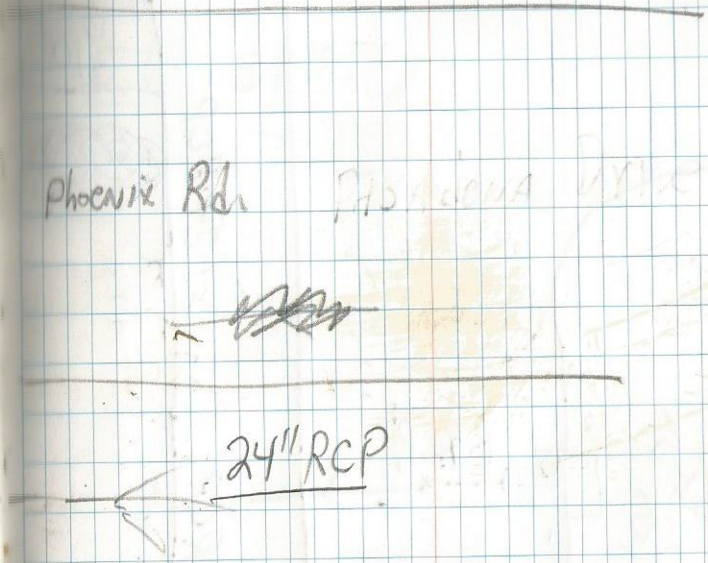


Notes

10-22-13

(13)

* CBI-3 has 18" diameter hole in back of box Adjoining MAIN LINE

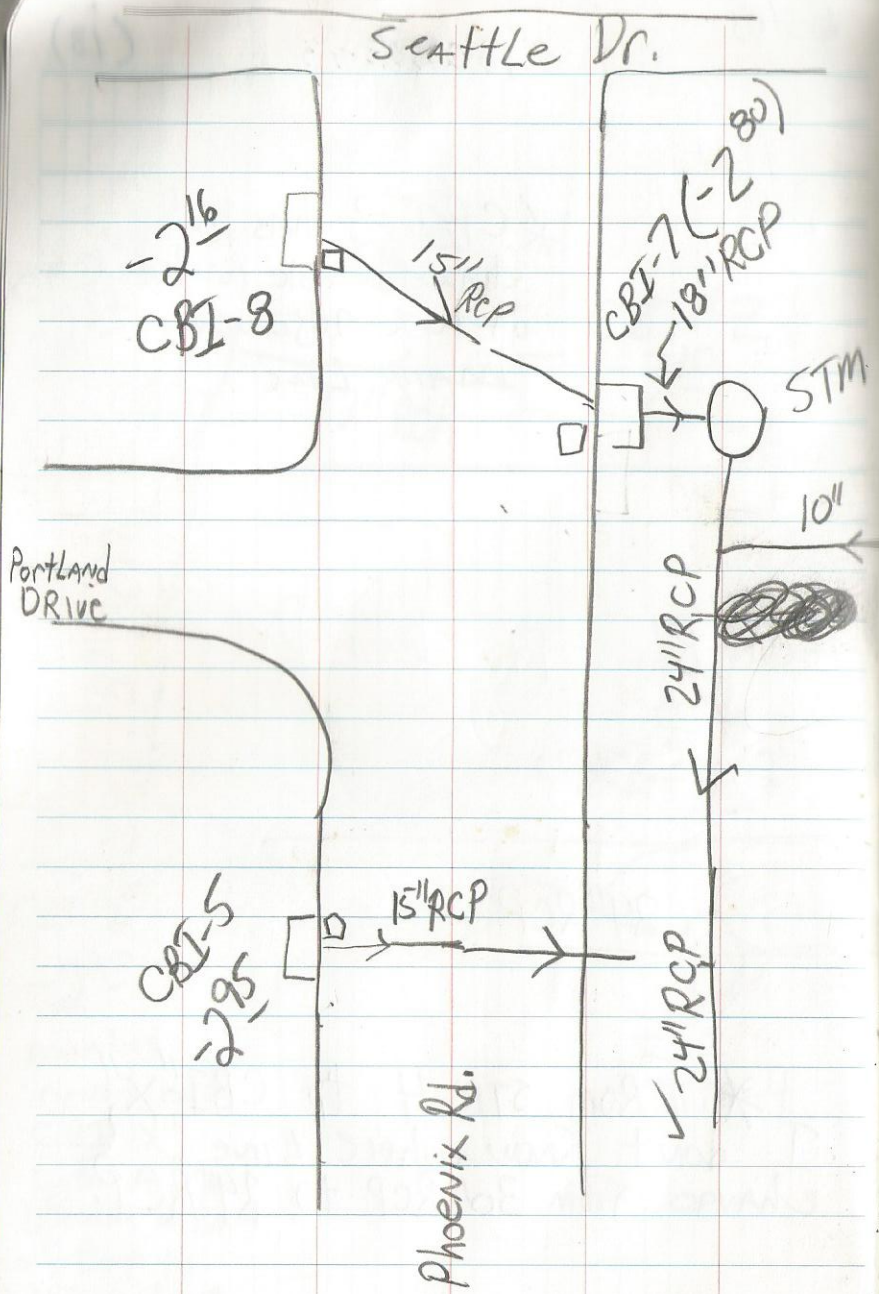


* From STM-4 to CBI-"X", I don't know where Line changes from 30" RCP to 24" RCP.

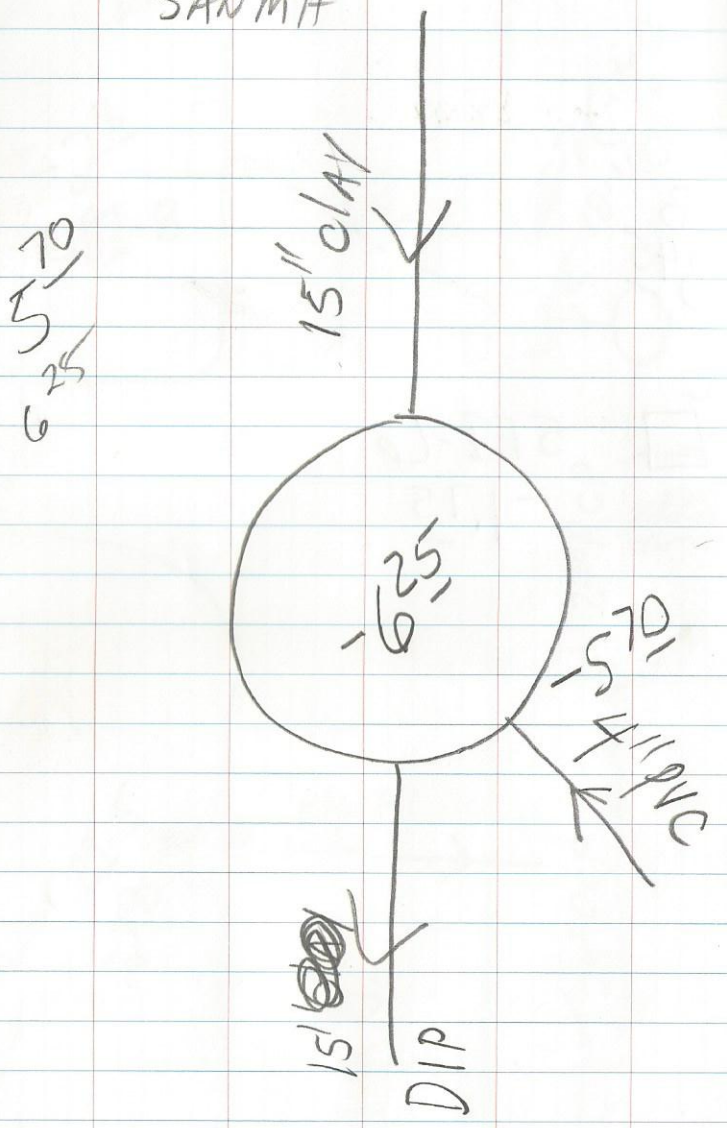
Estes

10-22-13

(14)



Sketch of #1502
SAN MH



Estes

10-22-13

(15)

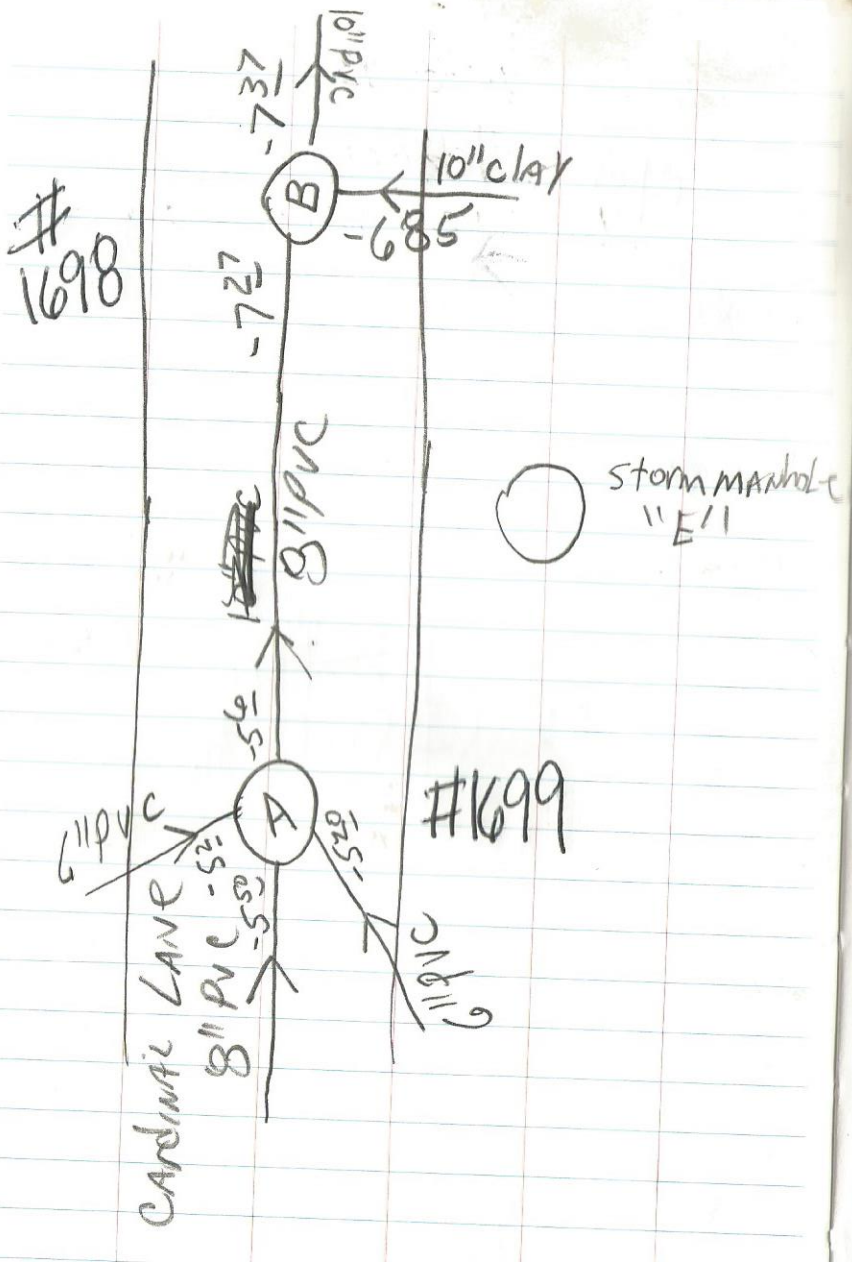
#130057

Charge Battery - 3v

LARAMIE Storm Sewer

LAST PAGE

#130057



Estes

10-30-13

(1)

#130057

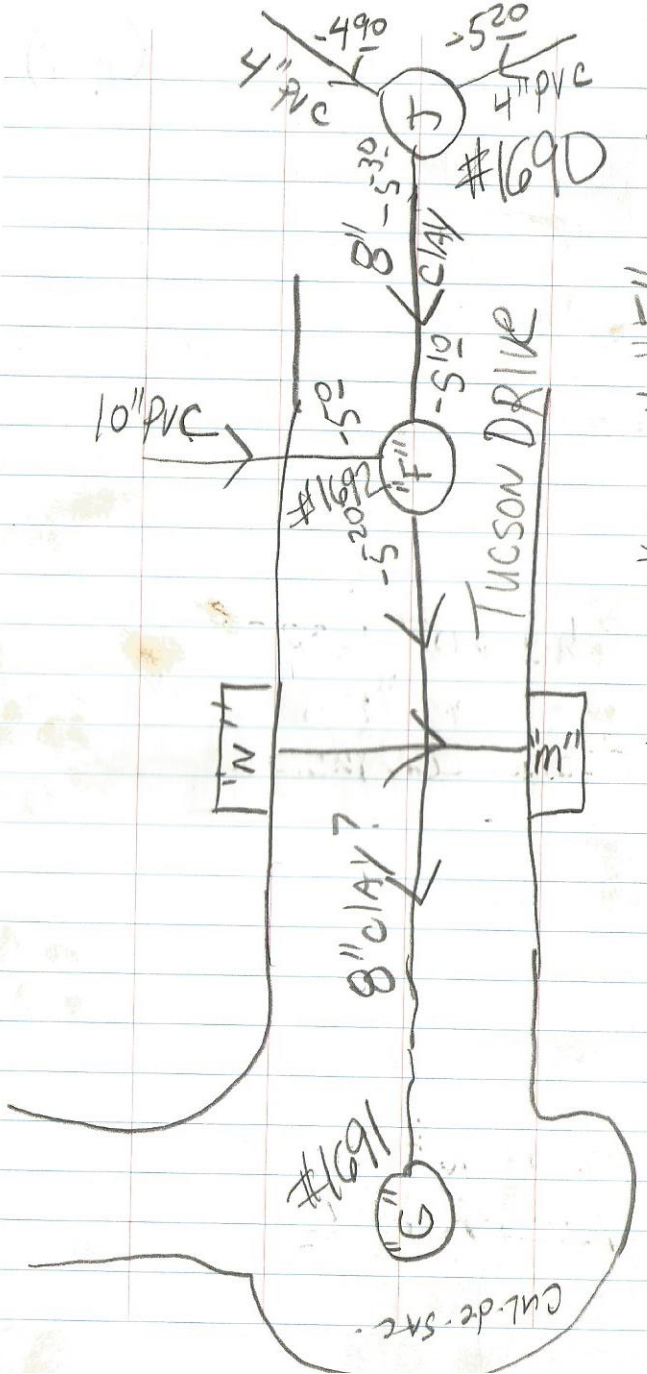
Laramie / Tucson Storm Sewer

Estes

10-30-13

#1360517

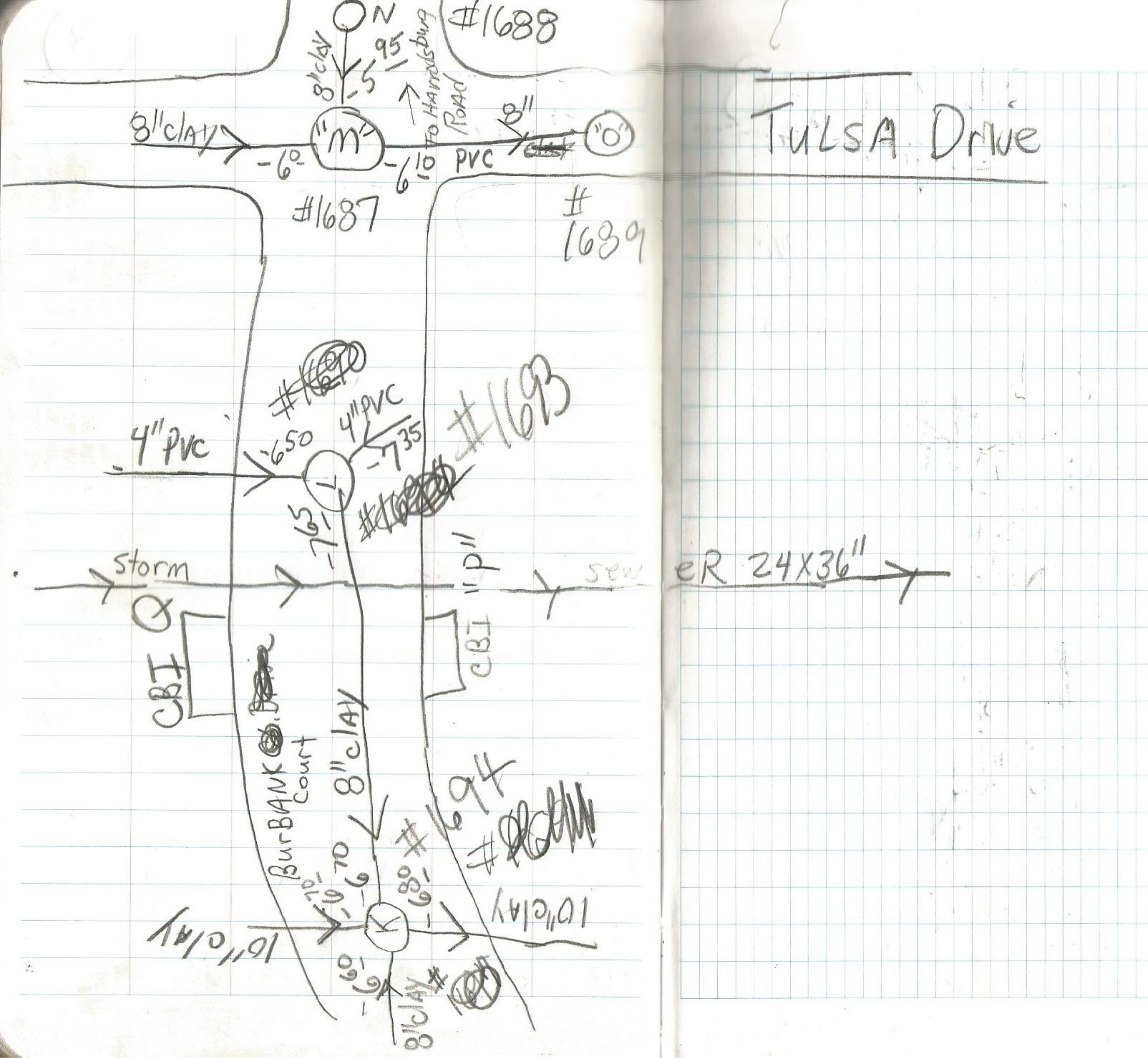
(2)

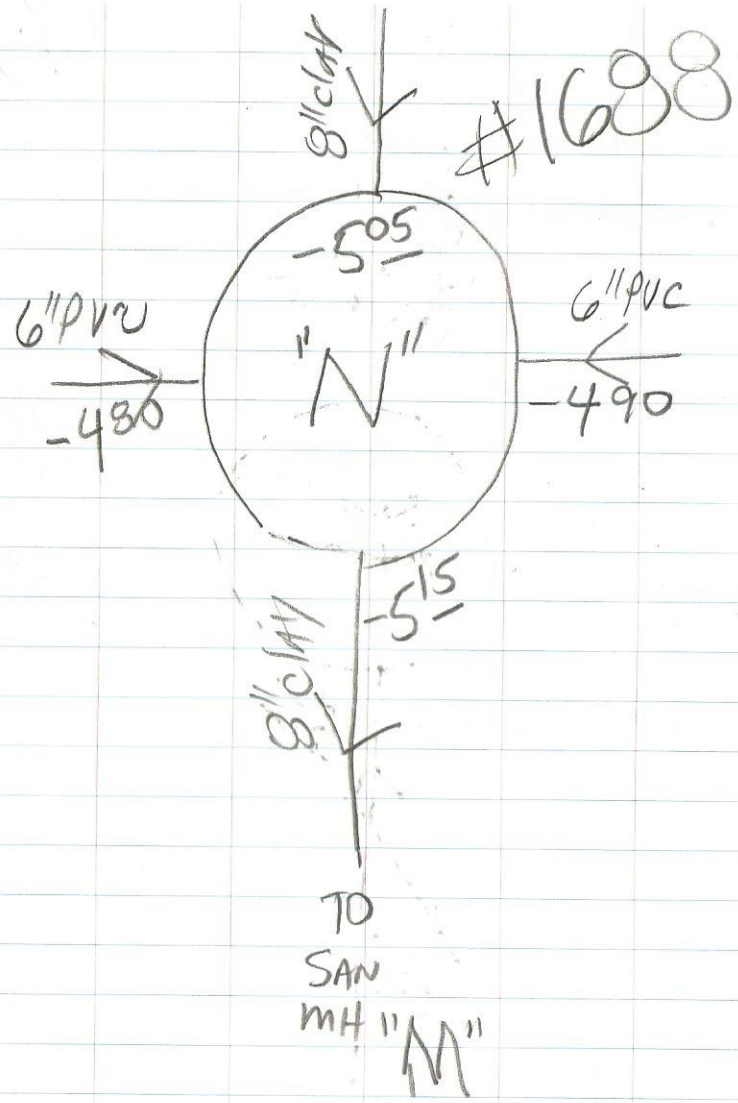


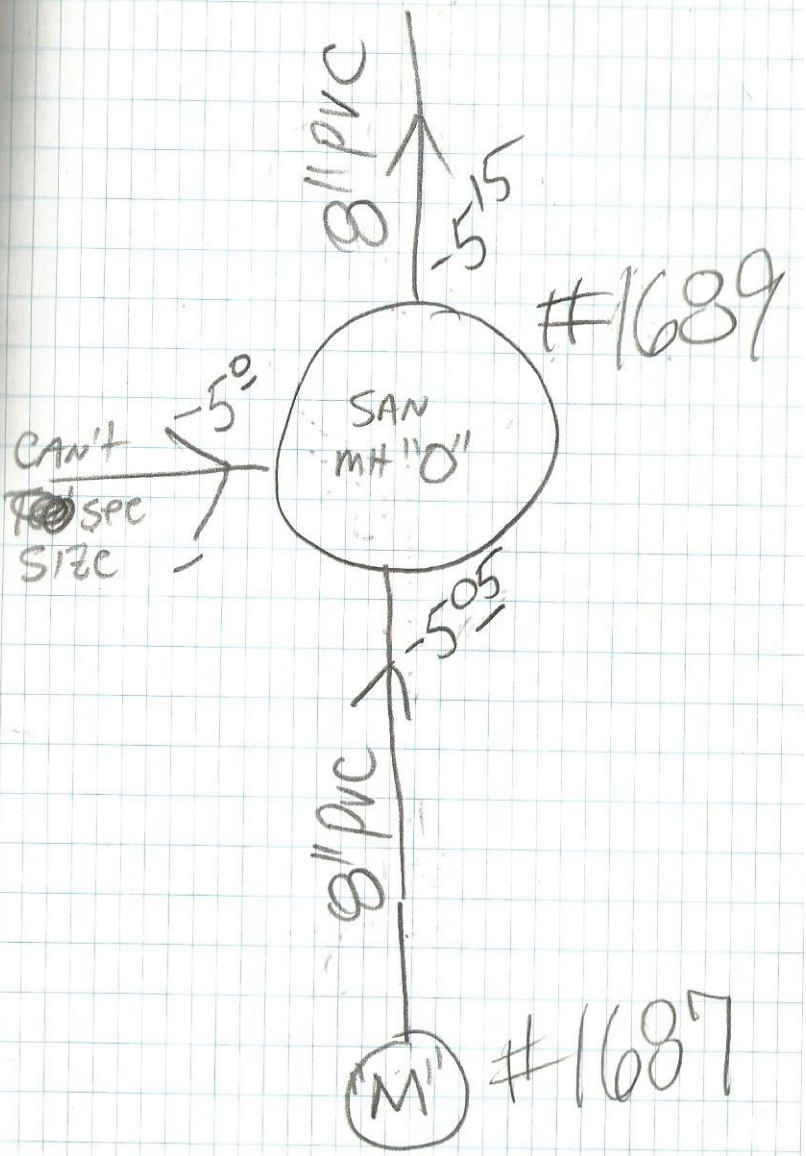
* SAN MH "F" needs help; obstructed flow seepic 3061-3063

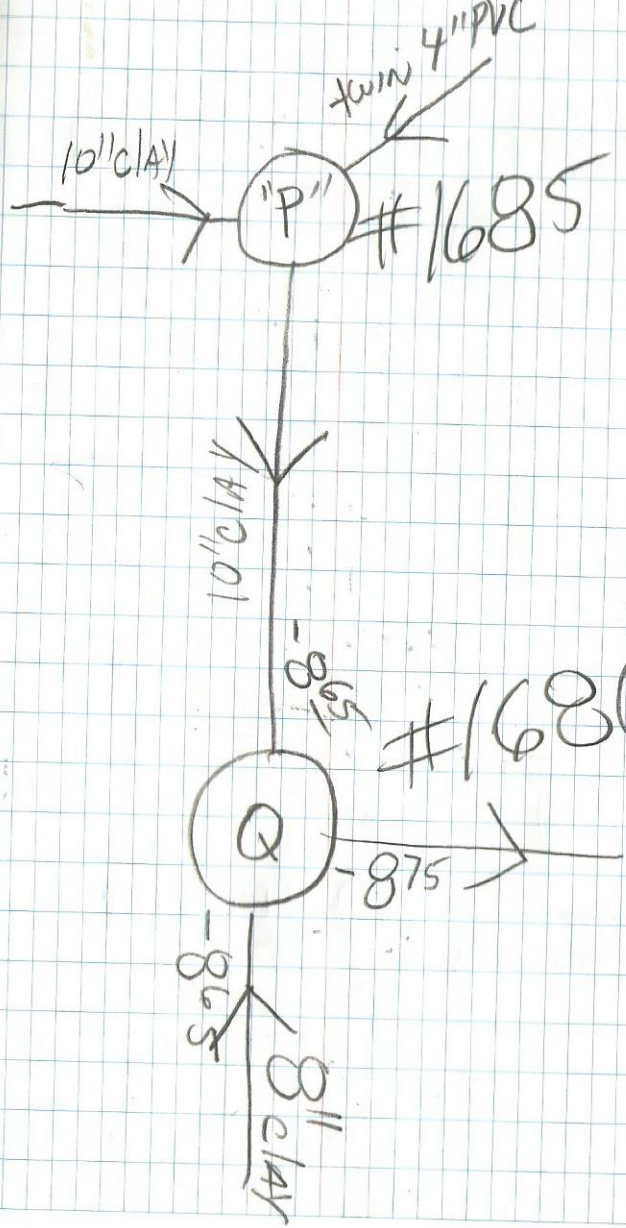
* I did not LABEL A SAN M "H" or "I" to AVOID CONFUSION

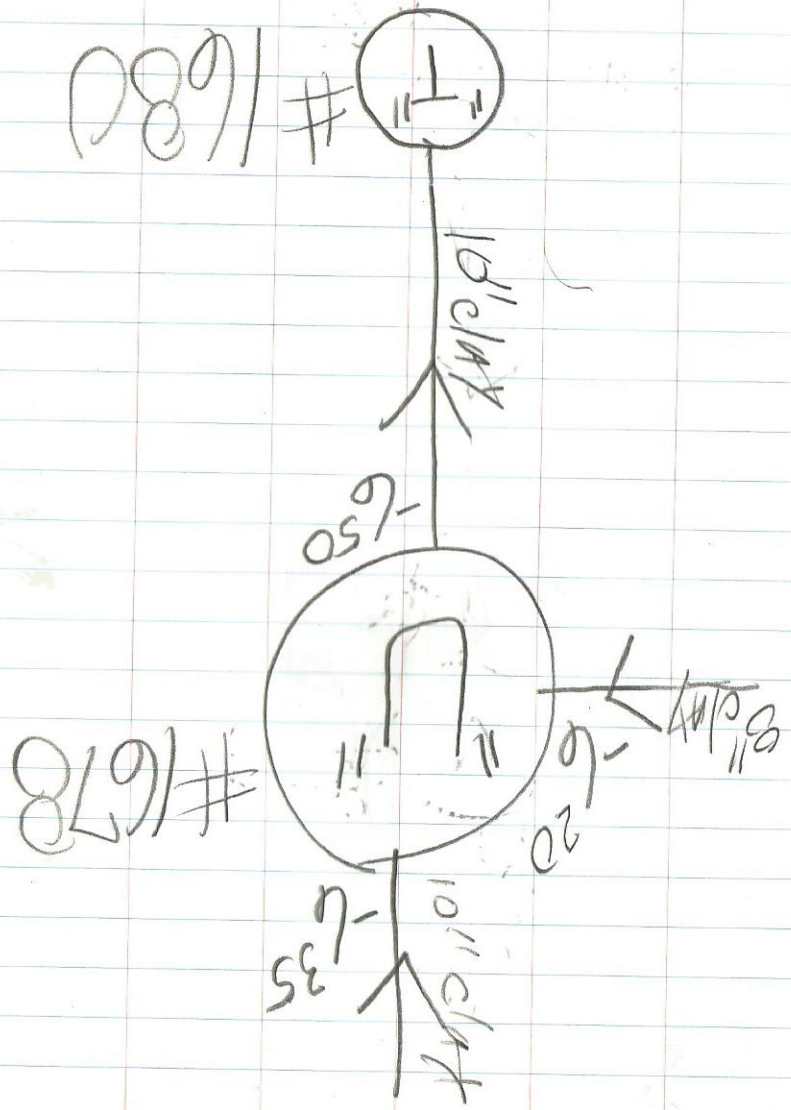
* I could not remove LID to MANHOLE "G"

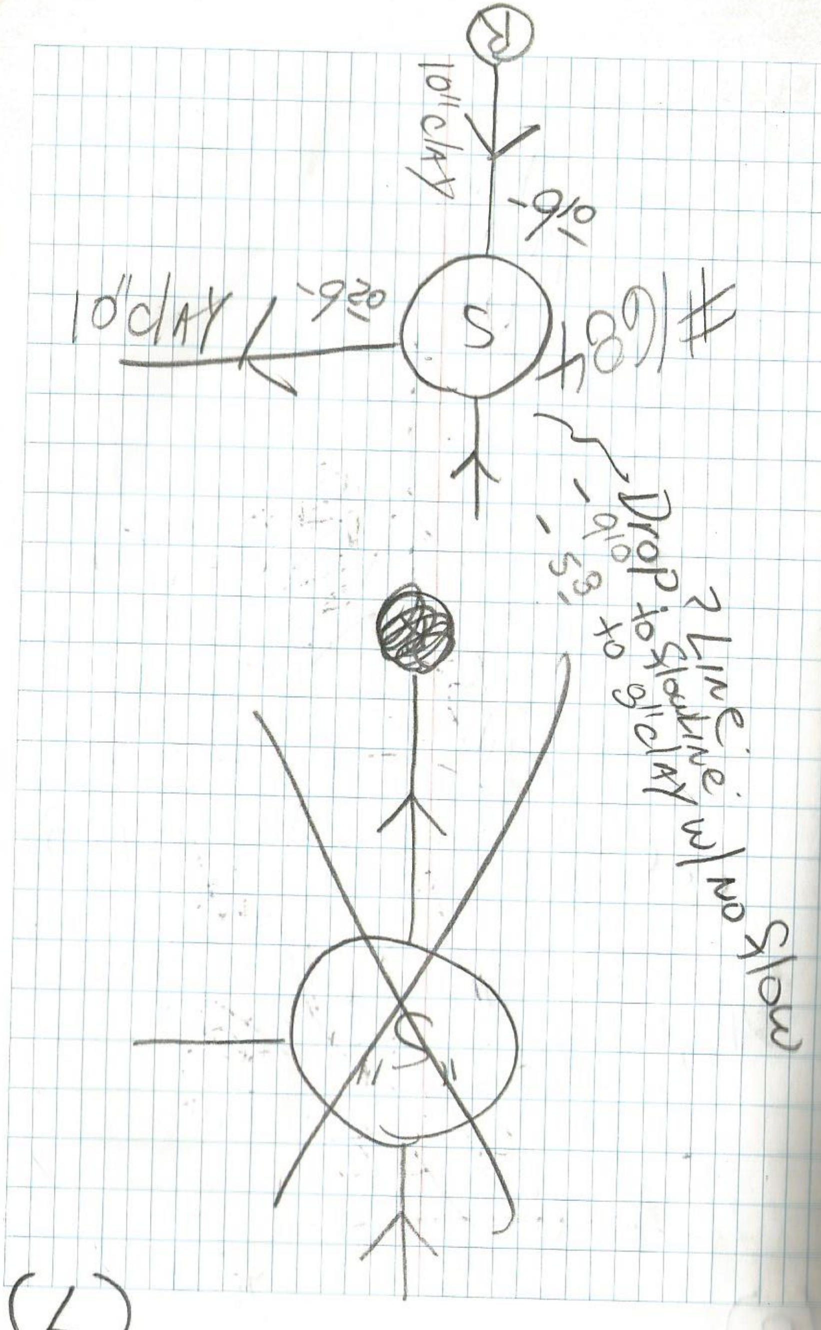

TULSA Drive
#1688
N
8"clay
-5.95
To Harrodsburg Road
8"clAY
-6.0
"M"
-6.10
PVC
8"
"O"
#1687
#1689
4"PVC
-6.50
4"PVC
-7.35
L
-7.65
#1693
Storm
sewer 24X36"
"P"
CBI
CBI
8"clAY
BurBANK Court
#1694
-6.70
-6.70
-6.80
K
10"clAY
10"clAY
-6.60
8"clAY


8" clay
#1688
-505
6" PVC
-480
"N"
6" PVC
-490
-515
8" clay
TO
SAN
MH "M"

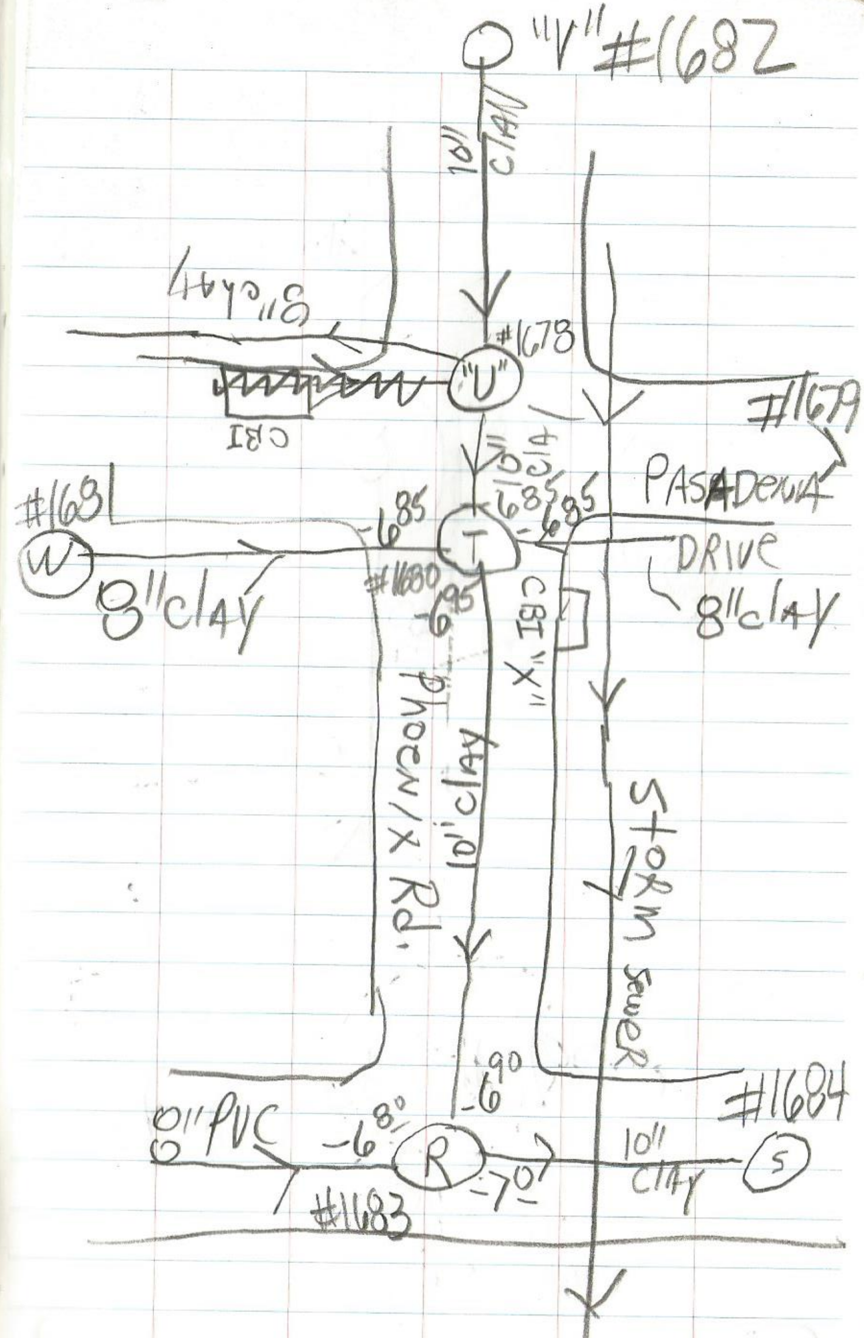

8" PVC
-515
#1689
SAN
MH "O"
-50
CAN'T
SIZE
-505
8" PVC
"M"
#1687


twin 4" PVC
10" clay
"P"
#1685
10" clay
-855
#1686
Q
-875
-855
8" clay


#1680
10" clay
-650
8" clay
-20
#1678
-635
10" clay



R
10" clay
-910
S
-920
10" clay
#1684
? Line Drop to Slowline w/ no flow
-910 to 8" clay
-53
S
(7)



"V" #1682
10" CLAY
8" clay
CBI
"U"
#1678
10" clay
-685
#1679
PASADENA DRIVE
8" clay
#1681
-685
W
8" clay
T
#1680
-695
CBI "X"
Phoen/x Rd.
10" clay
Storm sewer
-690
#1684
8" PVC
-680
R
-700
10" clay
S
#1683

#1682

(8)

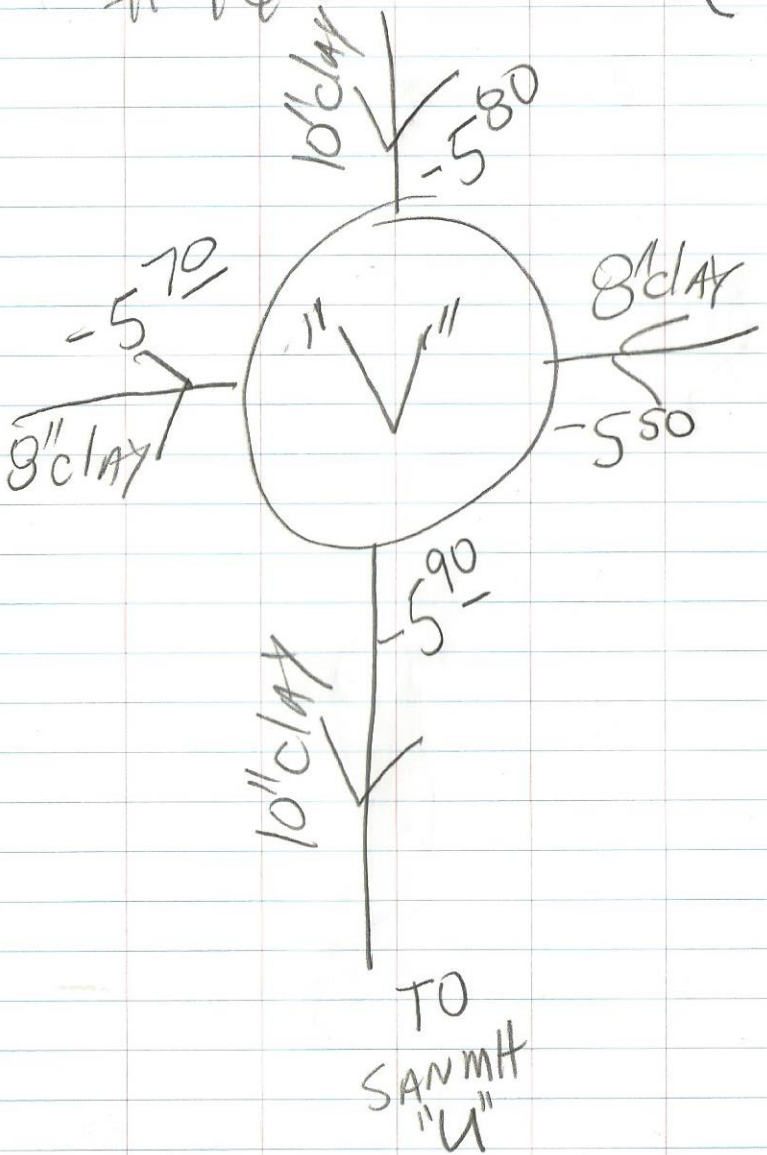


Photo 3026 – WR5_594CI

Photo 3027 – WR5_594CI

Photo 3028 – WR5_595CI

Photo 3029 – WR5_598MH

Photo 3030 – WR5_599CI

Photo 3031 – WR5_600CI

Photo 3032 – WR5_608CI

Photo 3033 – WR5_607CI

Photo 3034 – WR5_606CI

Photo 3035 – WR5_605CI

Photo 3036 – WR5_604CI

Photo 3037 – WR5_610CI

Photo 3038 – WR5_609CI

Photo 3039 – WR5_612CI

Photo 3040 – WR5_611CI

Photo 3041 – WR5_614CI

Photo 3042 – WR5_615CI

Photo 3043 – WR5_616CI

Photo 3044 – WR5_619CI

Photo 3045 – WR5_618CI

Photo 3046 – WR5_621CI

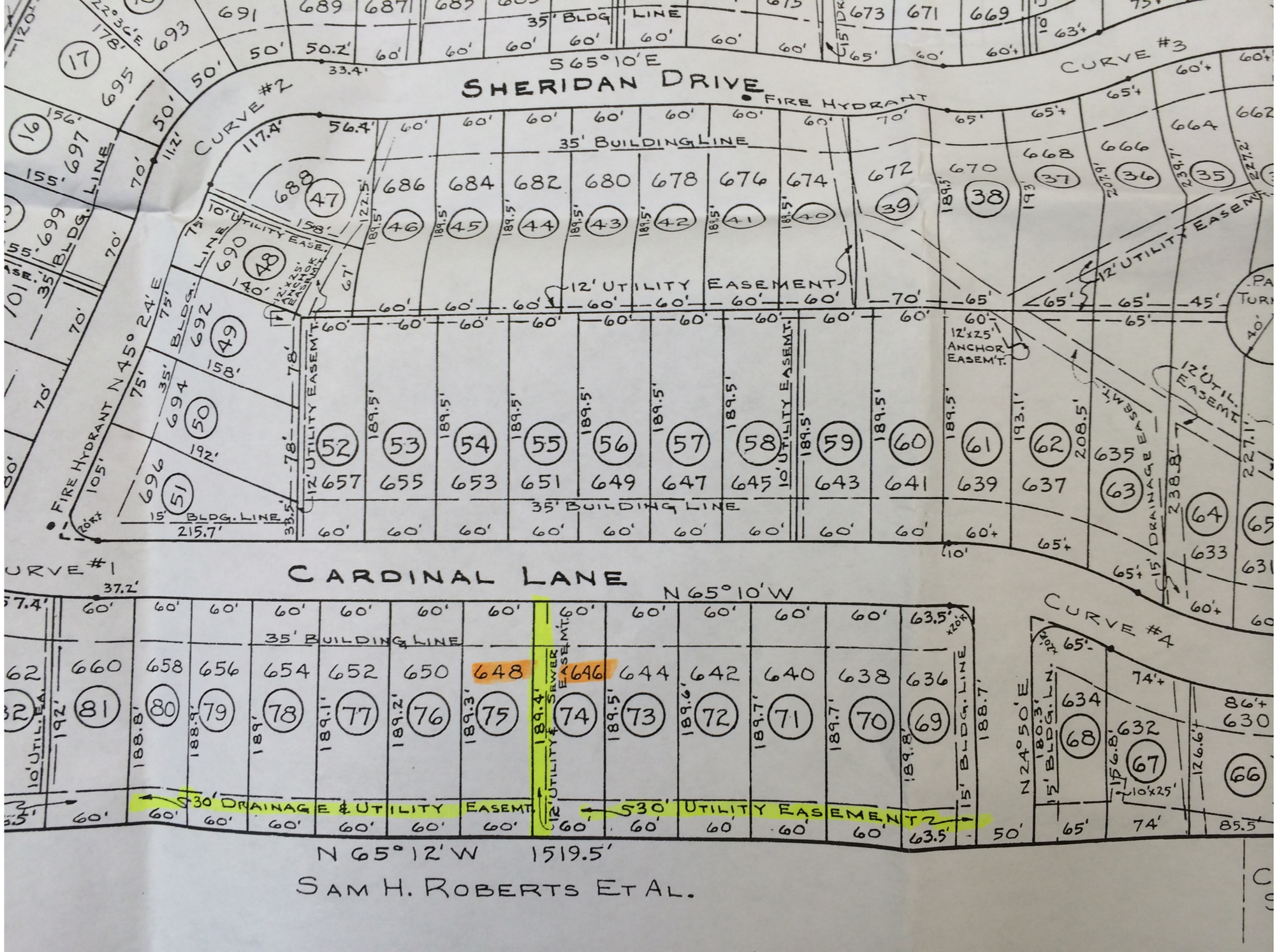
Photo 3047 – WR5_622SI

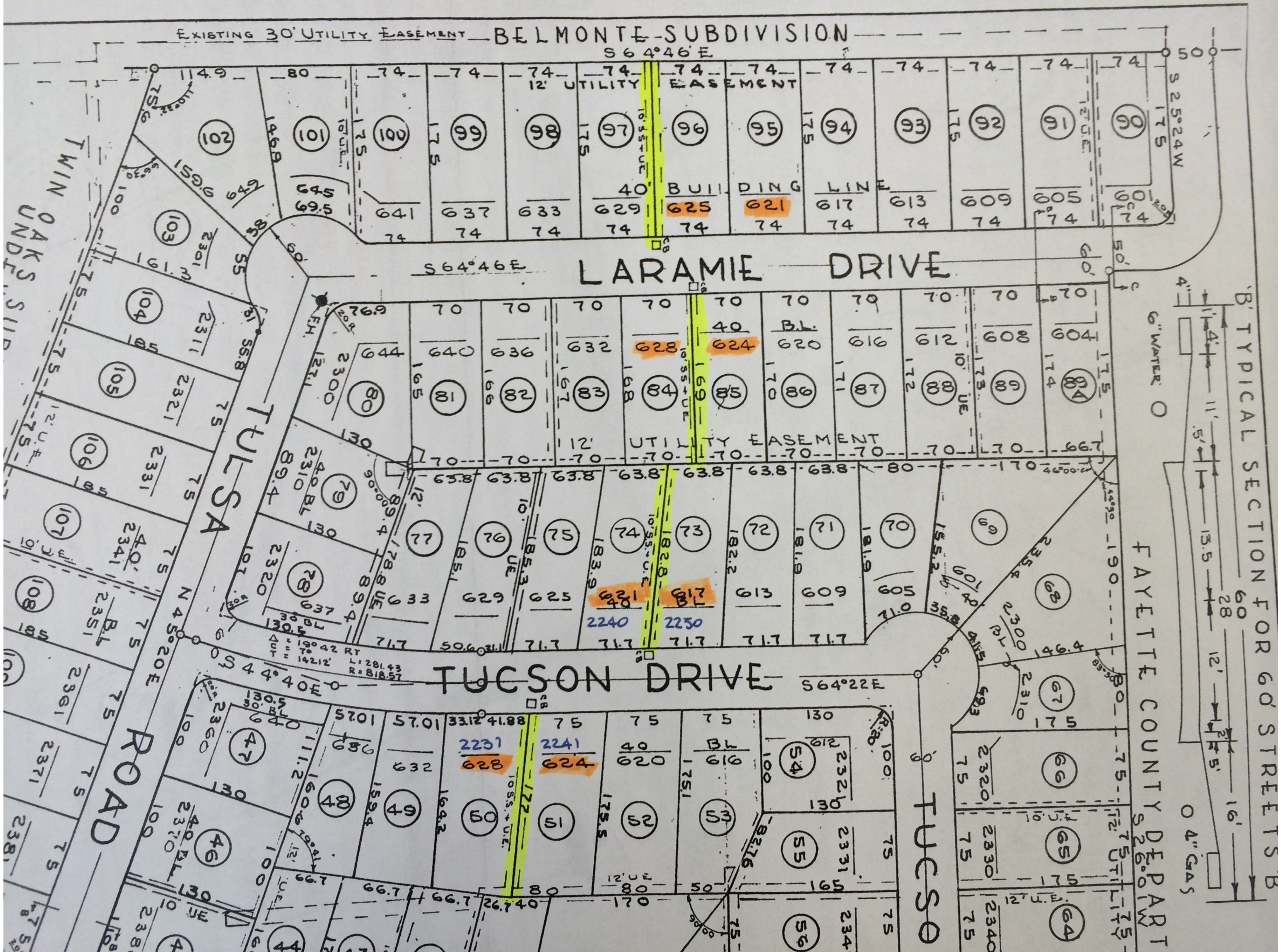
Photo 3048 – WR5_624CI

Photo 3049 – WR5_625CI

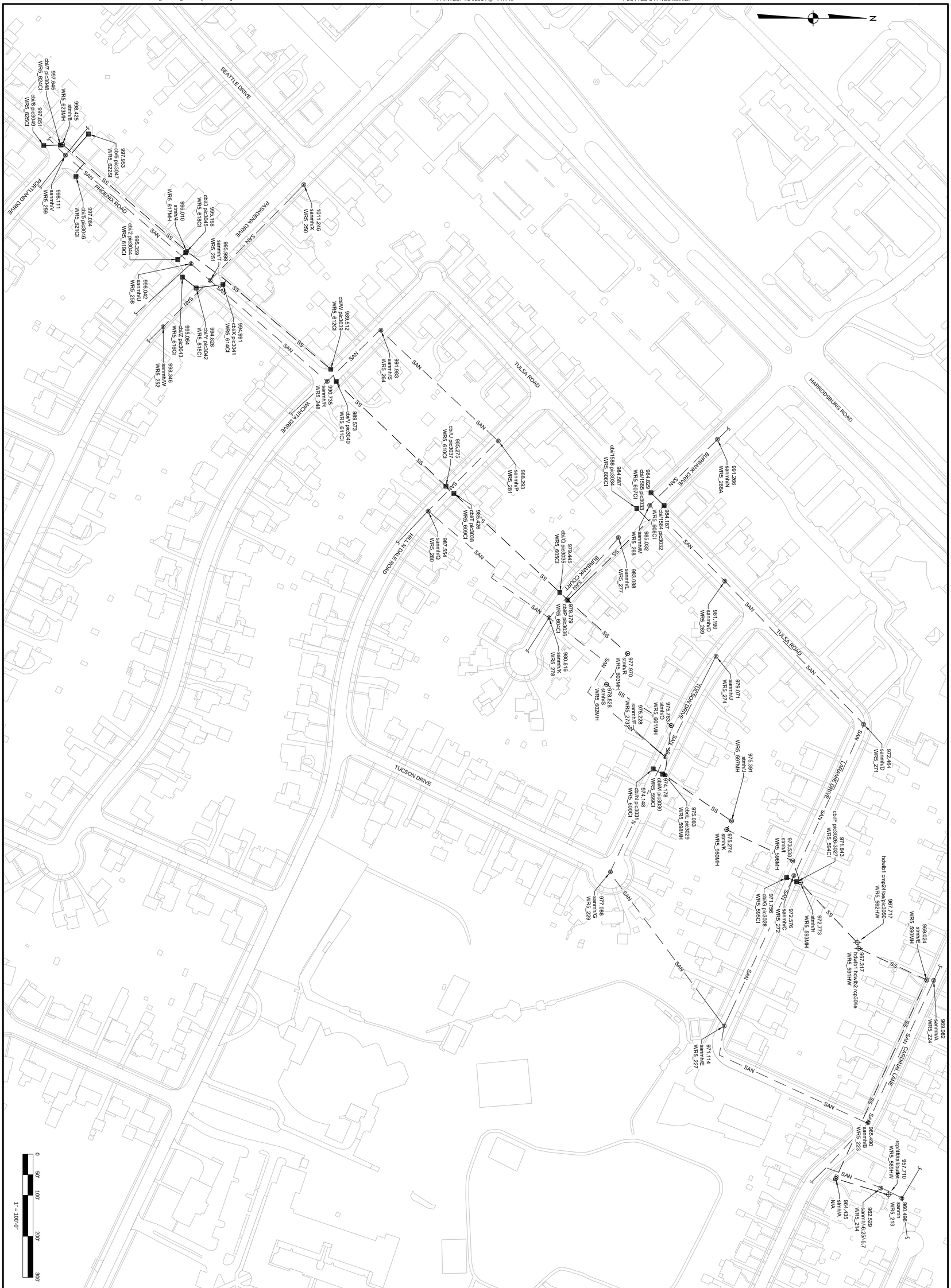
Photo 3050 – WR5_592HW

Photo 3053 – WR5_591HW


SHERIDAN DRIVE
S 65° 10' E
CURVE #2
CURVE #3
CURVE #1
CURVE #4
35' BUILDING LINE
FIRE HYDRANT
12' UTILITY EASEMENT
10' UTILITY EASEMT.
12'x25' ANCHOR EASEMT.
15' DRAINAGE EASEMT.
FIRE HYDRANT N 45° 24' E
CARDINAL LANE
N 65° 10' W
12' UTILITY & SEWER EASEMT.
30' DRAINAGE & UTILITY EASEMT.
30' UTILITY EASEMENT
N 24° 50' E
N 65° 12' W 1519.5'
SAM H. ROBERTS ET AL.



EXISTING 30' UTILITY EASEMENT
BELMONTE SUBDIVISION
S 64°46' E
12' UTILITY EASEMENT
40' BUILDING LINE
LARAMIE DRIVE
S 64°46' E
S 25°24' W
TWIN OAKS UNDIS. SUB
TULSA
ROAD
12' UTILITY EASEMENT
TUCSON DRIVE
S 44°40' E
S 64°22' E
TUCSO
6" WATER
4" GAS
FAYETTE COUNTY DEPART
'B' TYPICAL SECTION FOR 60' STREETS
2240
2250
2231
2241



EX.	1" = 100'	APRIL, 2014	

REVISIONS

NO.	DESCRIPTION	DATE	BY

SCALE CHECK: THIS MARK SHOULD MEASURE EXACTLY 1" WHEN PLOTTED

DESIGNED:
DRAWN:
REVIEWED:
APPROVED:

APPENDIX A
SURVEY DATA

TUCSON/LARAMIE PRELIMINARY ENGINEERING REPORT
CITY OF LEXINGTON, KENTUCKY

engineering | architecture | geospatial
www.grwinc.com

GRW PROJECT NO. 4008-08

CLIENT PROJECT NO. XXXX

APPENDIX B

Storm Drainage & Flooding Questionnaire
Tucson Drive Area

GRW Engineers · Architects · Planners

Dear Resident:

GRW has been hired by the City of Lexington to investigate flooding problems in your neighborhood. You may have been contacted in the past, so please bear with us as we determine the current situation. Your response is important to solving the flooding issues, even if you are not affected.

Please complete the survey and return in the stamped envelope by October 19, 2012. Thank you for your assistance.

Name: Manuel Shepherd Jr

Complete Address: 2220 Tucson Dr Lexington Ky 40503

Telephone Number: 859-608-7799

How long have you lived at this address? 7yrs

Has the inside of your home ever flooded during or after a storm? Yes ☐ No ☑

If yes, please estimate the month and year it occurred. Slight water in Basement During heavy RAIN

If yes, what part of the home floods? (basement? first floor? crawl space?) Please be specific.

Basement-

How did the water enter the home? (door? window? floor drain? seeped through walls? toilet or drain backup?)

Please be specific. Seeped thru walls

How many times has your home flooded? None: ☐ Once: ☑ Twice: ☐ 3 or more times: ☐

Does the flood water have an odor like sewage? Yes ☑ No ☐

Did you see sewage debris (toilet paper, etc) in the water? Yes ☐ No ☑

Does your street flood? Yes ☑ No ☐

If so, can cars pass? Yes ☐ No ☑

(Please add comments or sketches below or on the back of the page.)

On occasion some odor was present when heavy rains occurred and water seeped into the basement. During heavy RAINS the street is NOT PASSABLE.

Note: All information submitted is public and is available for public review.

Sent: October, 2012

Storm Drainage & Flooding Questionnaire
Tucson Drive Area

Engineers · Architects · Planners

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Name: KEVIN Tipton

Complete Address: 2221 TUCSON Dr.

Telephone Number: 859-373-8984

How long have you lived at this address? 10 yrs

Has the inside of your home ever flooded during or after a storm? Yes ☑ No ☐

If yes, please estimate the month and year it occurred. Multiple times in Spring & FALL

If yes, what part of the home floods? (basement? first floor? crawl space?) Please be specific.

Crawlspace - Ive installed French Drain & 2 Sump pumps, ALONG W/other work

How did the water enter the home? (door? window? floor drain? seeped through walls? toilet or drain backup?)

Please be specific. Im not sure but suspect through old Septic tank

How many times has your home flooded? None: ☐ Once: ☐ Twice: ☐ 3 or more times: ☑

Does the flood water have an odor like sewage? Yes ☐ No ☑

Did you see sewage debris (toilet paper, etc) in the water? Yes ☐ No ☑

So far every year I've lived here.

Does your street flood? Yes ☑ No ☐

If so, can cars pass? Yes ☐ No ☑

(Please add comments or sketches below or on the back of the page.)

When it rains consistently for 4 or 5 days my back yard has standing water & After about 3 days my crawlspace has about two feet of water. Just last week I paid A Contractor to come & dig up Septic tank pipe & Seal it on old septic tank & where the pipe came into the house. Not sure if this is the issue but I have tried everything else. Ive contacted the City several times but nothing was ever resolved. The flooding on the street is horrible. I hope this can get resolved →

Note: All information submitted is public and is available for public review.

Sent: October, 2012

There is A storm drain manhole on my back fence line & water will gush from it flooding the back yard & my suspicion is its seeping into the 'old' septic tank then entering the crawlspace. Its truly been a disaster in this neighborhood.

2221 Tucson Drive – Backyard during August 31, 2013 Storm

2221 Tucson Drive – Backyard during August 31, 2013 Storm

2221 Tucson Drive – Facing Northeast towards Tucson Drive during August 31, 2013 Storm

2221 Tucson Drive – Facing Northeast towards Tucson Drive during August 31, 2013 Storm

2221 Tucson Drive – Facing Northeast towards Tucson Drive during August 31, 2013 Storm

Storm Drainage & Flooding Questionnaire
Tucson Drive Area

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Name: Eugenia F Phillips

Complete Address: 2230 Tucson Drive, Lexington, Ky 40503

Telephone Number: 859-277-7295

How long have you lived at this address? 53 yrs

Has the inside of your home ever flooded during or after a storm? Yes ☒ No ☐

If yes, please estimate the month and year it occurred. Feb-March 1963-1964

If yes, what part of the home floods? (basement? first floor? crawl space?) Please be specific.

Basement - sump pump failure

How did the water enter the home? (door? window? floor drain? seeped through walls? toilet or drain backup?)

Please be specific. sump pump

How many times has your home flooded? None: ☐ Once: ☐ Twice: ☐ 3 or more times: ☒

Does the flood water have an odor like sewage? Yes ☐ No ☒

Did you see sewage debris (toilet paper, etc) in the water? Yes ☐ No ☒

Does your street flood? Yes ☒ No ☐

If so, can cars pass? Yes ☐ No ☒

(Please add comments or sketches below or on the back of the page.)

It would be easier if you could call me or come by. The street has flooded many times, it has gotten as high as the dash on cars and covered mail boxes when they were on the curb

Note: All information submitted is public and is available for public review.

Sent: October, 2012

LEXINGTON FAYETTE URBAN COUNTY GOVERNMENT KENTUCKY 1775

Storm Drainage & Flooding Questionnaire
Tucson Drive Area

GRW Engineers · Architects · Planners

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Please complete the survey and return in the stamped envelope by October 19, 2012. Thank you for your assistance.

Name: Mary B. Hurd

Complete Address: 2231 Tucson Drive, Lexington Ky. 40503

Telephone Number: 859-278-9131

How long have you lived at this address? Est. 30 Yrs or longer

Has the inside of your home ever flooded during or after a storm? Yes ☐ No ☒

If yes, please estimate the month and year it occurred. Any time it has a rainy time

If yes, what part of the home floods? (basement? first floor? crawl space?) Please be specific.
Water Come into Crawl space.

How did the water enter the home? (door? window? floor drain? seeped through walls? toilet or drain backup?)
Please be specific. Ever time it Comes a hard Rain "Real hard" it Comes from Storm Drainage

How many times has your home flooded? None: ☐ Once: ☐ Twice: ☐ 3 or more times: ☒

Does the flood water have an odor like sewage? Yes ☐ No ☒ damp

Did you see sewage debris (toilet paper, etc) in the water? Yes ☐ No ☒

Does your street flood? Yes ☒ No ☐

If so, can cars pass? Yes ☒ No ☒
Gets where Cars Can not pass fully covered + on part side Walks

(Please add comments or sketches below or on the back of the page.)

lawn gets Water from storm Drainage cross Back lot + down side - which storm drainage lawn runs - + Pressure - makes top Come (down next to Road) - off this big storm Drainage. as well as other places on the storm drainage. looks like a lake at that time

Note: All information submitted is public and is available for public review.

Sent: October, 2012

lots of holes Come in around + [illegible] where it goes + Corners are [illegible]

Nabor also gets water from Storm Dranage —

from other side Papper

where it makes a curve "Bend." — Storm Dranage

~~Todis~~ They come larger

& Spread more —

Close to bend &

on Storm Dranage-way

Storm Drainage & Flooding Questionnaire
Tucson Drive Area

Engineers · Architects · Planners

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Please complete the survey and return in the stamped envelope by October 19, 2012. Thank you for your assistance.

Name: Ralph Dailey

Complete Address: 2250 Tucson Dr

Telephone Number: 859-277-3210

How long have you lived at this address? 52 yrs.

Has the inside of your home ever flooded during or after a storm? Yes ☒ No ☐

If yes, please estimate the month and year it occurred. _____

If yes, what part of the home floods? (basement? first floor? crawl space?) Please be specific.

due to electric being off & we didn't have a generator

How did the water enter the home? (door? window? ~~floor drain~~? seeped through walls? toilet or drain backup?)

Please be specific. no electricity

How many times has your home flooded? None: ☐ Once: ☒ Twice: ☐ 3 or more times: ☐

Does the flood water have an odor like sewage? Yes ☐ No ☒

Did you see sewage debris (toilet paper, etc) in the water? Yes ☐ No ☒

Does your street flood? Yes ☒ No ☐

If so, can cars pass? Yes ☐ No ☒

(Please add comments or sketches below or on the back of the page.)

We have water high in the yard ever since we moved here. The cap on the drain comes off & water shoots out of it.
We have had promises to fix it for 52 yrs.

B J. Dailey

Note: All information submitted is public and is available for public review.

Sent: October, 2012

Storm Drainage & Flooding Questionnaire
Tucson Drive Area

GRW Engineers · Architects · Planners

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Name: RUSSELL TPITMAN

Complete Address: 609 BURBANK CT

Telephone Number: 859-219-0486

How long have you lived at this address? 2 YEARS

Has the inside of your home ever flooded during or after a storm? Yes ☐ No ☑

If yes, please estimate the month and year it occurred. _____

If yes, what part of the home floods? (basement? first floor? crawl space?) Please be specific.

_____

How did the water enter the home? (door? window? floor drain? seeped through walls? toilet or drain backup?)

Please be specific. _____

How many times has your home flooded? None: ☑ Once: ☐ Twice: ☐ 3 or more times: ☐

Does the flood water have an odor like sewage? Yes ☐ No ☐

Did you see sewage debris (toilet paper, etc) in the water? Yes ☐ No ☑

Does your street flood? Yes ☐ No ☑

If so, can cars pass? Yes ☐ No ☐

(Please add comments or sketches below or on the back of the page.)

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Sent: October, 2012

Storm Drainage & Flooding Questionnaire
Tucson Drive Area

GRW Engineers · Architects · Planners

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Please complete the survey and return in the stamped envelope by October 19, 2012. Thank you for your assistance.

Name: Edward B Kelly

Complete Address: 616 Burbank Ct.

Telephone Number: 859-276-5331

How long have you lived at this address? 9 yrs.

Has the inside of your home ever flooded during or after a storm? Yes ☐ No ☑

If yes, please estimate the month and year it occurred. _____

If yes, what part of the home floods? (basement? first floor? crawl space?) Please be specific.

_____

How did the water enter the home? (door? window? floor drain? seeped through walls? toilet or drain backup?)

Please be specific. _____

How many times has your home flooded? None: ☐ Once: ☐ Twice: ☐ 3 or more times: ☐

Does the flood water have an odor like sewage? Yes ☐ No ☐

Did you see sewage debris (toilet paper, etc) in the water? Yes ☐ No ☐

Does your street flood? Yes ☐ No ☑

If so, can cars pass? Yes ☐ No ☐

(Please add comments or sketches below or on the back of the page.)

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Sent: October, 2012

Storm Drainage & Flooding Questionnaire
Tucson Drive Area

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Name: Mrs. Thirza Ellis

Complete Address: 679 Hill N., Dale Rd. Lexington, KY 40503

Telephone Number: 75 859-277-2368

How long have you lived at this address? 52 years

Has the inside of your home ever flooded during or after a storm? Yes ☐ No ☒

If yes, please estimate the month and year it occurred. _____

If yes, what part of the home floods? (basement? first floor? crawl space?) Please be specific.

_____

How did the water enter the home? (door? window? floor drain? seeped through walls? toilet or drain backup?)

Please be specific. _____

How many times has your home flooded? None: ☒ Once: ☐ Twice: ☐ 3 or more times: ☐

Does the flood water have an odor like sewage? Yes ☐ No ☐

Did you see sewage debris (toilet paper, etc) in the water? Yes ☐ No ☐

Does your street flood? Yes ☐ No ☒

If so, can cars pass? Yes ☐ No ☐

(Please add comments or sketches below or on the back of the page.)

In 2003 during the ice storm + electricity was off for 6 days we had some seepage in garage + laundry room in the basement — 688 and 690 homes have had problems with water in the basement and possibly others on this street

Note: All information submitted is public and is available for public review.

Sent: October, 2012

Storm Drainage & Flooding Questionnaire
Tucson Drive Area

Engineers · Architects · Planners

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Please complete the survey and return in the stamped envelope by October 19, 2012. Thank you for your assistance.

Name: Tory Ackerman

Complete Address: 682 Hill n Dale Road

Telephone Number: 351-1245

How long have you lived at this address? 9½ years

Has the inside of your home ever flooded during or after a storm? Yes ☐ No ☑

If yes, please estimate the month and year it occurred. _____

If yes, what part of the home floods? (basement? first floor? crawl space?) Please be specific.

_____

How did the water enter the home? (door? window? floor drain? seeped through walls? toilet or drain backup?)

Please be specific. _____

How many times has your home flooded? None: ☑ Once: ☐ Twice: ☐ 3 or more times: ☐

Does the flood water have an odor like sewage? Yes ☐ No ☐

Did you see sewage debris (toilet paper, etc) in the water? Yes ☐ No ☐

Does your street flood? Yes ☐ No ☐

If so, can cars pass? Yes ☐ No ☐

(Please add comments or sketches below or on the back of the page.)

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Sent: October, 2012

Storm Drainage & Flooding Questionnaire
Tucson Drive Area

Engineers · Architects · Planners

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Name: David C. Leachman

Complete Address: 686 Hill-N-Dale Rd

Telephone Number: (859) 948-236

How long have you lived at this address? 6years

Has the inside of your home ever flooded during or after a storm? Yes ☑ No ☐

If yes, please estimate the month and year it occurred. When it rains over 3inches in the winter & spring

If yes, what part of the home floods? (basement? first floor? crawl space?) Please be specific.

Basement

How did the water enter the home? (door? window? floor drain? seeped through walls? toilet or drain backup?)

Please be specific. I have two cracks in my foundation at my basement window here

How many times has your home flooded? None: ☐ Once: ☐ Twice: ☐ 3 or more times: ☑ water comes in.

Does the flood water have an odor like sewage? Yes ☐ No ☑

Did you see sewage debris (toilet paper, etc) in the water? Yes ☐ No ☑

Does your street flood? Yes ☐ No ☑

If so, can cars pass? Yes ☐ No ☐

(Please add comments or sketches below or on the back of the page.)

I'm a landscape architect and know a little bit about storm water. When it rains over 3inches and the leaves are not on the trees we get water in our basement from two seperat cracks in my foundation. Now, the portion of Tucson that runs east west has a low point where cars cant pass when it rains a bunch. Also when it rains a lot behind my house turns into a stream when the ground water is full. there is . . .

Note: All information submitted is public and is available for public review.

Sent: October, 2012

... low point and drain ~~behind~~ in the rear of 694 Hill N Dale that collects water. I also have a drain in my driveway that collects a lot of this water. Call me if you want.

(859) 948 2363

Storm Drainage & Flooding Questionnaire
Tucson Drive Area

Engineers · Architects · Planners

Dear Resident:

GRW has been hired by the City of Lexington to investigate flooding problems in your neighborhood. You may have been contacted in the past, so please bear with us as we determine the current situation. Your response is important to solving the flooding issues, even if you are not affected.

Please complete the survey and return in the stamped envelope by October 19, 2012. Thank you for your assistance.

Name: Emery J. Mayes

Complete Address: 687 Hillen-Dee Rd., Lexington, Ky 40503

Telephone Number: 859-277-2874

How long have you lived at this address? 52 yrs.

Has the inside of your home ever flooded during or after a storm? Yes ☐ No ☒

If yes, please estimate the month and year it occurred. _____

If yes, what part of the home floods? (basement? first floor? crawl space?) Please be specific.

_____

How did the water enter the home? (door? window? floor drain? seeped through walls? toilet or drain backup?)

Please be specific. _____

How many times has your home flooded? None: ☐ Once: ☐ Twice: ☐ 3 or more times: ☐

Does the flood water have an odor like sewage? Yes ☐ No ☐

Did you see sewage debris (toilet paper, etc) in the water? Yes ☐ No ☐

Does your street flood? Yes ☐ No ☒

If so, can cars pass? Yes ☐ No ☐

(Please add comments or sketches below or on the back of the page.)

Note: All information submitted is public and is available for public review.

Sent: October, 2012

Storm Drainage & Flooding Questionnaire
Tucson Drive Area

GRW Engineers · Architects · Planners

Dear Resident:

GRW has been hired by the City of Lexington to investigate flooding problems in your neighborhood. You may have been contacted in the past, so please bear with us as we determine the current situation. Your response is important to solving the flooding issues, even if you are not affected.

Please complete the survey and return in the stamped envelope by October 19, 2012. Thank you for your assistance.

Name: Gregory Colton

Complete Address: 1691 Hill N Dale Rd

Telephone Number: _____

How long have you lived at this address? 15 yrs

Has the inside of your home ever flooded during or after a storm? Yes ☐ No ☒

If yes, please estimate the month and year it occurred. _____

If yes, what part of the home floods? (basement? first floor? crawl space?) Please be specific.

_____

How did the water enter the home? (door? window? floor drain? seeped through walls? toilet or drain backup?)

Please be specific. _____

How many times has your home flooded? None: ☒ Once: ☐ Twice: ☐ 3 or more times: ☐

Does the flood water have an odor like sewage? Yes ☐ No ☐

Did you see sewage debris (toilet paper, etc) in the water? Yes ☐ No ☐

Does your street flood? Yes ☐ No ☒

If so, can cars pass? Yes ☐ No ☐

(Please add comments or sketches below or on the back of the page.)

Note: All information submitted is public and is available for public review.

Sent: October, 2012

APPENDIX C

Alternative 2
Preliminary Opinion of Probable Cost
Tucson/Laramie
Lexington, Kentucky
August 18, 2014

Item No.	Item	Quantity	Unit	Unit Price	Amount
1	54-inch RCP Storm Sewer Pipe	1164	LF	$ 251	$ 292,164
2	48-inch RCP Storm Sewer Pipe	819	LF	$ 202	$ 165,438
3	42-inch RCP Storm Sewer Pipe	27	LF	$ 156	$ 4,212
4	36-inch RCP Storm Sewer Pipe	1246	LF	$ 125	$ 155,750
5	30-inch RCP Storm Sewer Pipe	4	LF	$ 106	$ 424
6	24-inch RCP Storm Sewer Pipe	92	LF	$ 82	$ 7,544
7	18-inch RCP Storm Sewer Pipe	27	LF	$ 77	$ 2,079
8	Curb Inlet Type B	13	EA	$ 4,303	$ 55,939
9	8-foot Manhole	4	EA	$ 7,211	$ 28,844
10	6-foot Manhole	6	EA	$ 4,633	$ 27,798
11	Headwall/Wingwalls	1	EA	$ 10,000	$ 10,000
12	Sod	340	SQ YD	$ 6	$ 2,040
13	Erosion Control	1	LS	$ 5,000	$ 5,000
14	Temporary Construction Easements	18	EA	$ 100	$ 1,800

ESTIMATED CONSTRUCTION COST	**$**	**759,032**
30% Construction Contingency	$	227,710
TOTAL ESTIMATED CONSTRUCTION COST	**$**	**986,742**
Engineering	$	87,523
TOTAL ESTIMATED PROJECT COST	**$**	**1,074,265**

*Unit costs for Items No. 3,4, and 7-10 from LFUCG Bid dated September 6, 2013
*Unit costs for Items No. 1,2,5, and 6 from KTC Bid dated 2012
and adjusted to reflect the LFUCG Bid prices
*30% Contingency used for potential increases in material and construction costs

Alternative 2 A
Preliminary Opinion of Probable Cost
Tucson/Laramie
Lexington, Kentucky
August 18, 2014

Item No.	Item	Quantity	Unit	Unit Price	Amount
1	54-inch HDPE Storm Sewer Pipe	1164	LF	$ 196	$ 228,144
2	48-inch HDPE Storm Sewer Pipe	819	LF	$ 155	$ 126,945
3	42-inch HDPE Storm Sewer Pipe	27	LF	$ 123	$ 3,321
4	36-inch HDPE Storm Sewer Pipe	1246	LF	$ 98	$ 122,108
5	30-inch HDPE Storm Sewer Pipe	4	LF	$ 82	$ 328
6	24-inch HDPE Storm Sewer Pipe	92	LF	$ 75	$ 6,900
7	18-inch HDPE Storm Sewer Pipe	27	LF	$ 69	$ 1,863
8	Curb Inlet Type B	13	EA	$ 4,303	$ 55,939
9	8-foot Manhole	4	EA	$ 7,211	$ 28,844
10	6-foot Manhole	6	EA	$ 4,633	$ 27,798
11	Headwall/Wingwalls	1	EA	$ 10,000	$ 10,000
12	Sod	340	SQ YD	$ 6	$ 2,040
13	Erosion Control	1	LS	$ 5,000	$ 5,000
14	Temporary Construction Easements	18	EA	$ 100	$ 1,800

ESTIMATED CONSTRUCTION COST	**$ 621,030**
30% Construction Contingency	$ 186,309
TOTAL ESTIMATED CONSTRUCTION COST	**$ 807,339**
Engineering	$ 74,157
TOTAL ESTIMATED PROJECT COST	**$ 881,496**

*Unit costs for Items No. 3,4, and 7-10 from LFUCG Bid dated September 6, 2013
*Unit costs for Items No. 1,2,5, and 6 from KTC Bid dated 2012
and adjusted to reflect the LFUCG Bid prices
*30% Contingency used for potential increases in material and construction costs

Alternative 3
Preliminary Opinion of Probable Cost
Tucson/Laramie
Lexington, Kentucky
August 18, 2014

Item No.	Item	Quantity	Unit	Unit Price	Amount
1	54-inch RCP Storm Sewer Pipe	146	LF	$ 251	$ 36,646
2	48-inch RCP Storm Sewer Pipe	1651	LF	$ 202	$ 333,502
3	42-inch RCP Storm Sewer Pipe	313	LF	$ 156	$ 48,828
4	36-inch RCP Storm Sewer Pipe	1233	LF	$ 125	$ 154,125
5	30-inch RCP Storm Sewer Pipe	4	LF	$ 106	$ 424
6	24-inch RCP Storm Sewer Pipe	83	LF	$ 82	$ 6,806
7	Curb Inlet Type B	12	EA	$ 4,303	$ 51,636
8	6-foot Manhole	9	EA	$ 4,633	$ 41,697
9	Sod	380	SQ YD	$ 6	$ 2,280
10	Erosion Control	1	LS	$ 5,000	$ 5,000
11	Easement	1	LS	$ 1,000	$ 1,000
12	Temporary Construction Easement	11	EA	$ 100	$ 1,100

ESTIMATED CONSTRUCTION COST	**$ 683,044**
30% Construction Contingency	$ 204,914
TOTAL ESTIMATED CONSTRUCTION COST	**$ 887,958**
Engineering	$ 80,130
TOTAL ESTIMATED PROJECT COST	**$ 968,088**

*Unit costs for Items No. 3,4, and 7-9 from LFUCG Bid dated September 6, 2013
*Unit costs for Items No. 1,2,4, and 5 from KTC Bid dated 2012
and adjusted to reflect the LFUCG Bid prices
*30% Contingency used for potential increases in material and construction costs

Alternative 3 A
Preliminary Opinion of Probable Cost
Tucson/Laramie
Lexington, Kentucky
August 18, 2014

Item No.	Item	Quantity	Unit	Unit Price	Amount
1	54-inch HDPE Storm Sewer Pipe	146	LF	$ 196	$ 28,616
2	48-inch HDPE Storm Sewer Pipe	1651	LF	$ 155	$ 255,905
3	42-inch HDPE Storm Sewer Pipe	313	LF	$ 123	$ 38,499
4	36-inch HDPE Storm Sewer Pipe	1233	LF	$ 98	$ 120,834
5	30-inch HDPE Storm Sewer Pipe	4	LF	$ 82	$ 328
6	24-inch HDPE Storm Sewer Pipe	83	LF	$ 75	$ 6,225
7	Curb Inlet Type B	12	EA	$ 4,303	$ 51,636
8	6-foot Manhole	9	EA	$ 4,633	$ 41,697
9	Sod	380	SQ YD	$ 6	$ 2,280
10	Erosion Control	1	LS	$ 5,000	$ 5,000
11	Easement	1	LS	$ 1,000	$ 1,000
12	Temporary Construction Easement	11	EA	$ 100	$ 1,100

ESTIMATED CONSTRUCTION COST	**$ 553,120**
30% Construction Contingency	$ 165,936
TOTAL ESTIMATED CONSTRUCTION COST	**$ 719,056**
Engineering	$ 67,608
TOTAL ESTIMATED PROJECT COST	**$ 786,664**

*Unit costs for Items No. 3,4, and 7-9 from LFUCG Bid dated September 6, 2013
*Unit costs for Items No. 1,2,4, and 5 from KTC Bid dated 2012
and adjusted to reflect the LFUCG Bid prices
*30% Contingency used for potential increases in material and construction costs

Alternative 4
Preliminary Opinion of Probable Cost
Tucson/Laramie
Lexington, Kentucky
August 18, 2014

Item No.	Item	Quantity	Unit	Unit Price	Amount
1	54-inch RCP Storm Sewer Pipe	389	LF	$ 251	$ 97,639
2	48-inch RCP Storm Sewer Pipe	364	LF	$ 202	$ 73,528
3	42-inch RCP Storm Sewer Pipe	1356	LF	$ 156	$ 211,536
4	36-inch RCP Storm Sewer Pipe	1800	LF	$ 125	$ 225,000
5	30-inch RCP Storm Sewer Pipe	439	LF	$ 106	$ 46,534
6	24-inch RCP Storm Sewer Pipe	83	LF	$ 82	$ 6,806
7	18-inch RCP Storm Sewer Pipe	36	LF	$ 77	$ 2,772
8	Curb Inlet Type B	14	EA	$ 4,303	$ 60,242
9	6-foot Manhole	13	EA	$ 4,633	$ 60,229
10	Headwall/Wingwalls	1	EA	$ 10,000	$ 10,000
11	Sod	430	SQ YD	$ 6	$ 2,580
12	Erosion Control	1	LS	$ 5,000	$ 5,000
13	Easement	1	EA	$ 1,000	$ 1,000
14	Temporary Construction Easement	15	EA	$ 100	$ 1,500

ESTIMATED CONSTRUCTION COST	**$**	**804,366**
30% Construction Contingency	$	241,310
TOTAL ESTIMATED CONSTRUCTION COST	**$**	**1,045,676**
Engineering	$	91,969
TOTAL ESTIMATED PROJECT COST	**$**	**1,137,645**

*Unit costs for Items No. 3,5,9, and 10-13 from LFUCG Bid dated September 6, 2013
*Unit costs for Items No. 1,2,7, and 8 from KTC Bid dated 2012
and adjusted to reflect the LFUCG Bid prices
*Unit costs for Items No. 5 and6 from GRW Bid dated November 30, 2012
*30% Contingency used for potential increases in material and construction costs

Alternative 4 A
Preliminary Opinion of Probable Cost
Tucson/Laramie
Lexington, Kentucky
August 18, 2014

Item No.	Item	Quantity	Unit	Unit Price	Amount
1	54-inch RCP Storm Sewer Pipe	389	LF	$ 196	$ 76,244
2	48-inch HDPE Storm Sewer Pipe	364	LF	$ 155	$ 56,420
3	42-inch HDPE Storm Sewer Pipe	1356	LF	$ 123	$ 166,788
4	36-inch HDPE Storm Sewer Pipe	1800	LF	$ 98	$ 176,400
5	30-inch HDPE Storm Sewer Pipe	439	LF	$ 82	$ 35,998
6	24-inch HDPE Storm Sewer Pipe	83	LF	$ 75	$ 6,225
7	18-inch HDPE Storm Sewer Pipe	36	LF	$ 69	$ 2,484
8	Curb Inlet Type B	14	EA	$ 4,303	$ 60,242
9	6-foot Manhole	13	EA	$ 4,633	$ 60,229
10	Headwall/Wingwalls	1	EA	$ 10,000	$ 10,000
11	Sod	430	SQ YD	$ 6	$ 2,580
12	Erosion Control	1	LS	$ 5,000	$ 5,000
13	Easement	1	EA	$ 1,000	$ 1,000
14	Temporary Construction Easement	15	EA	$ 100	$ 1,500

ESTIMATED CONSTRUCTION COST	**$ 661,110**
30% Construction Contingency	$ 198,333
TOTAL ESTIMATED CONSTRUCTION COST	**$ 859,443**
Engineering	$ 78,047
TOTAL ESTIMATED PROJECT COST	**$ 937,490**

*Unit costs for Items No. 3,5,9, and 10-13 from LFUCG Bid dated September 6, 2013
*Unit costs for Items No. 1,2,7, and 8 from KTC Bid dated 2012
and adjusted to reflect the LFUCG Bid prices
*Unit costs for Items No. 5 and6 from GRW Bid dated November 30, 2012
*30% Contingency used for potential increases in material and construction costs

Alternative 5
Preliminary Opinion of Probable Cost
Tucson/Laramie
Lexington, Kentucky
August 18, 2014

Item No.	Item	Quantity	Unit	Unit Price	Amount
1	2221 Tucson Drive	1	EA	$ 131,880	$ 131,880
2	2231 Tucson Drive	1	EA	$ 142,200	$ 142,200
3	2240 Tucson Drive	1	EA	$ 159,600	$ 159,600
4	2241 Tucson Drive	1	EA	$ 155,400	$ 155,400
5	2250 Tucson Drive	1	EA	$ 183,600	$ 183,600
6	621 Laramie Drive	1	EA	$ 174,840	$ 174,840
7	624 Laramie Drive	1	EA	$ 116,160	$ 116,160
8	625 Laramie Drive	1	EA	$ 168,000	$ 168,000
9	628 Laramie Drive	1	EA	$ 135,600	$ 135,600
10	Demolition	9	EA	$ 25,000	$ 225,000
11	Sod	700	SQ YD	$ 6	$ 4,200
12	Erosion Control	1	LS	$ 5,000	$ 5,000
ESTIMATED CONSTRUCTION COST					**$ 1,601,480**
30% Construction Contingency					$ 480,444
TOTAL ESTIMATED CONSTRUCTION COST					**$ 2,081,924**

*Value of properties from Fayette-PVA plus 20% for acquisition, taxes, and other fees.
*30% Contingency used for potential increases in material and construction costs

Alternative 6
Preliminary Opinion of Probable Cost
Tucson/Laramie
Lexington, Kentucky
August 18, 2014

Item No.	Item	Quantity	Unit	Unit Price	Amount
1	2221 Tucson Drive	1	EA	$ 131,880	$ 131,880
2	2231 Tucson Drive	1	EA	$ 142,200	$ 142,200
3	2241 Tucson Drive	1	EA	$ 155,400	$ 155,400
4	2251 Tucson Drive	1	EA	$ 160,680	$ 160,680
5	609 Burbank Court	1	EA	$ 150,000	$ 150,000
6	613 Burbank Court	1	EA	$ 150,000	$ 150,000
7	617 Burbank Court	1	EA	$ 133,080	$ 133,080
8	Demolition	7	EA	$ 25,000	$ 175,000
9	36-inch RCP Storm Sewer Pipe	2871	LF	$ 125	$ 358,875
10	30-inch RCP Storm Sewer Pipe	4	LF	$ 106	$ 424
11	24-inch RCP Storm Sewer Pipe	92	LF	$ 82	$ 7,544
12	18-inch RCP Storm Sewer Pipe	27	LF	$ 77	$ 2,079
13	Curb Inlet Type B	13	EA	$ 4,303	$ 55,939
14	6-foot Manhole	8	EA	$ 4,633	$ 37,064
15	Headwall/Wingwall	3	EA	$ 10,000	$ 30,000
16	Excavation	25000	CU YD	$ 20	$ 500,000
17	Sod	1205	SQ YD	$ 6	$ 7,230
18	Basin Restoration	9631	SQ YD	$ 6	$ 57,786
19	Erosion Control	1	LS	$ 5,000	$ 5,000
20	Temporary Construction Easement	15	EA	$ 100	$ 1,500

ESTIMATED CONSTRUCTION COST	**$ 2,129,801**
30% Construction Contingency	$ 638,941
TOTAL ESTIMATED CONSTRUCTION COST	**$ 2,768,742**
Engineering	$ 202,656
TOTAL ESTIMATED PROJECT COST	**$ 2,971,398**

*Unit costs for Items No. 8 & 9 from LFUCG Bid dated September 6, 2013
*Unit costs for Items No. 10-13 from KTC Bid dated 2012
* Valve of properties from Fayette-PVA. 20% added from acquisition, taxes, and other fees
*30% Contingency used for potential increases in material and construction costs

Alternative 6 A
Preliminary Opinion of Probable Cost
Tucson/Laramie
Lexington, Kentucky
August 18, 2014

Item No.	Item	Quantity	Unit	Unit Price	Amount
1	2221 Tucson Drive	1	EA	$ 131,880	$ 131,880
2	2231 Tucson Drive	1	EA	$ 142,200	$ 142,200
3	2241 Tucson Drive	1	EA	$ 155,400	$ 155,400
4	2251 Tucson Drive	1	EA	$ 160,680	$ 160,680
5	609 Burbank Court	1	EA	$ 150,000	$ 150,000
6	613 Burbank Court	1	EA	$ 150,000	$ 150,000
7	617 Burbank Court	1	EA	$ 133,080	$ 133,080
8	Demolition	7	EA	$ 25,000	$ 175,000
9	36-inch HDPE Storm Sewer Pipe	2871	LF	$ 98	$ 281,358
10	30-inch HDPE Storm Sewer Pipe	4	LF	$ 82	$ 328
11	24-inch HDPE Storm Sewer Pipe	92	LF	$ 75	$ 6,900
12	18-inch HDPE Storm Sewer Pipe	27	LF	$ 69	$ 1,863
13	Curb Inlet Type B	13	EA	$ 4,303	$ 55,939
14	6-foot Manhole	8	EA	$ 4,633	$ 37,064
15	Headwall/Wingwall	3	EA	$ 10,000	$ 30,000
16	Excavation	25000	CU YD	$ 20	$ 500,000
17	Sod	1205	SQ YD	$ 6	$ 7,230
18	Basin Restoration	9631	SQ YD	$ 6	$ 57,786
19	Erosion Control	1	LS	$ 5,000	$ 5,000
20	Temporary Construction Easement	15	EA	$ 100	$ 1,500

ESTIMATED CONSTRUCTION COST	**$ 2,051,328**
30% Construction Contingency	$ 615,399
TOTAL ESTIMATED CONSTRUCTION COST	**$ 2,666,727**
Engineering	$ 196,484
TOTAL ESTIMATED PROJECT COST	**$ 2,863,211**

*Unit costs for Items No. 7-9 from LFUCG Bid dated September 6, 2013
*Unit costs for Items No. 10-13 from KTC Bid dated 2012
* Valve of properties from Fayette-PVA. 20% added from acquisition, taxes, and other fees
*30% Contingency used for potential increases in material and construction costs

Alternative 7
Preliminary Opinion of Probable Cost
Tucson/Laramie
Lexington, Kentucky
August 18, 2014

Item No.	Item	Quantity	Unit	Unit Price	Amount
1	48-inch RCP Storm Sewer Pipe	822	LF	$ 202	$ 166,044
2	42-inch RCP Storm Sewer Pipe	313	LF	$ 156	$ 48,828
3	36-inch RCP Storm Sewer Pipe	1379	LF	$ 125	$ 172,375
4	30-inch RCP Storm Sewer Pipe	471	LF	$ 106	$ 49,926
5	24-inch RCP Storm Sewer Pipe	83	LF	$ 82	$ 6,806
6	Curb Inlet Type B	12	EA	$ 4,303	$ 51,636
7	6-foot Manhole	9	EA	$ 4,633	$ 41,697
8	Headwall/Wingwall	2	EA	$ 10,000	$ 20,000
9	Detention Basin Excavation	27100	CU YD	$ 20	$ 542,000
10	Sod	990	SQ YD	$ 6	$ 5,940
11	Basin Restoration	11687	SQ YD	$ 6	$ 70,122
12	Erosion Control	1	LS	$ 5,000	$ 5,000
13	Easement	1	LS	$ 1,000	$ 1,000
14	Temporary Construction Easement	11	EA	$ 100	$ 1,100

ESTIMATED CONSTRUCTION COST	**$ 1,182,474**
30% Construction Contingency	$ 354,743
TOTAL ESTIMATED CONSTRUCTION COST	**$ 1,537,217**
Engineering	$ 126,134
Property Acquisition for Detention Basin	$ 300,000
TOTAL ESTIMATED PROJECT COST	**$ 1,963,351**

*Unit costs for Items No. 2,3, and 6-8 from LFUCG Bid dated September 6, 2013
*Unit costs for Items No. 1,3, and 4 from KTC Bid dated 2012
and adjusted to reflect the LFUCG Bid prices
*30% Contingency used for potential increases in material and construction costs

Alternative 7 A
Preliminary Opinion of Probable Cost
Tucson/Laramie
Lexington, Kentucky
August 18, 2014

Item No.	Item	Quantity	Unit	Unit Price	Amount
1	48-inch HDPE Storm Sewer Pipe	822	LF	$ 155	$ 127,410
2	42-inch HDPE Storm Sewer Pipe	313	LF	$ 123	$ 38,499
3	36-inch HDPE Storm Sewer Pipe	1379	LF	$ 98	$ 135,142
4	30-inch HDPE Storm Sewer Pipe	471	LF	$ 82	$ 38,622
5	24-inch HDPE Storm Sewer Pipe	83	LF	$ 75	$ 6,225
6	Curb Inlet Type B	12	EA	$ 4,303	$ 51,636
7	6-foot Manhole	9	EA	$ 4,633	$ 41,697
8	Headwall/Wingwall	2	EA	$ 10,000	$ 20,000
9	Detention Basin Excavation	27100	CU YD	$ 20	$ 542,000
10	Sod	990	SQ YD	$ 6	$ 5,940
11	Basin Restoration	11687	SQ YD	$ 6	$ 70,122
12	Erosion Control	1	LS	$ 5,000	$ 5,000
13	Easement	1	LS	$ 1,000	$ 1,000
14	Temporary Construction Easement	11	EA	$ 100	$ 1,100

ESTIMATED CONSTRUCTION COST	**$ 1,084,393**
30% Construction Contingency	$ 325,318
TOTAL ESTIMATED CONSTRUCTION COST	**$ 1,409,711**
Engineering	$ 117,829
Property Acquisition for Detention Basin	$ 300,000
TOTAL ESTIMATED PROJECT COST	**$ 1,827,540**

*Unit costs for Items No. 2,3, and 6-8 from LFUCG Bid dated September 6, 2013
*Unit costs for Items No. 1,3, and 4 from KTC Bid dated 2012
and adjusted to reflect the LFUCG Bid prices
*30% Contingency used for potential increases in material and construction costs

Alternative 8
Preliminary Opinion of Probable Cost
Tucson/Laramie
Lexington, Kentucky
August 18, 2014

Item No.	Item	Quantity	Unit	Unit Price	Amount
1	48-inch RCP Storm Sewer Pipe	808	LF	$ 202	$ 163,216
2	42-inch RCP Storm Sewer Pipe	343	LF	$ 156	$ 53,508
3	36-inch RCP Storm Sewer Pipe	1379	LF	$ 125	$ 172,375
4	30-inch RCP Storm Sewer Pipe	504	LF	$ 106	$ 53,424
5	24-inch RCP Storm Sewer Pipe	83	LF	$ 82	$ 6,806
6	Curb Inlet Type B	12	EA	$ 4,303	$ 51,636
7	6-foot Manhole	9	EA	$ 4,633	$ 41,697
8	Underground Detention Basin Bottom Slab	2400	CU YD	$ 400	$ 960,000
9	Underground Detention Basin Walls	153	CU YD	$ 500	$ 76,500
10	Underground Detention Basin Top Slab	2400	CU YD	$ 700	$ 1,680,000
11	Excavation	27100	CU YD	$ 20	$ 542,000
12	Sod	873	SQ YD	$ 6	$ 5,238
13	Basin Restoration	7391	SQ YD	$ 6	$ 44,346
14	Erosion Control	1	LS	$ 5,000	$ 5,000
15	Easement	1	LS	$ 1,000	$ 1,000
16	Temporary Construction Easement	11	EA	$ 100	$ 1,100

ESTIMATED CONSTRUCTION COST	**$ 3,857,846**
30% Construction Contingency	$ 1,157,354
TOTAL ESTIMATED CONSTRUCTION COST	**$ 5,015,200**
Engineering	$ 338,450
TOTAL ESTIMATED PROJECT COST	**$ 5,353,650**

*Unit costs for Items No. 2,3, and 6-8 from LFUCG Bid dated September 6, 2013
*Unit costs for Items No. 1,3, and 4 from KTC Bid dated 2012
and adjusted to reflect the LFUCG Bid prices
*30% Contingency used for potential increases in material and construction costs

Alternative 8 A
Preliminary Opinion of Probable Cost
Tucson/Laramie
Lexington, Kentucky
August 18, 2014

Item No.	Item	Quantity	Unit	Unit Price	Amount
1	48-inch HDPE Storm Sewer Pipe	808	LF	$ 155	$ 125,240
2	42-inch HDPE Storm Sewer Pipe	343	LF	$ 123	$ 42,189
3	36-inch HDPE Storm Sewer Pipe	1379	LF	$ 98	$ 135,142
4	30-inch HDPE Storm Sewer Pipe	504	LF	$ 82	$ 41,328
5	24-inch HDPE Storm Sewer Pipe	83	LF	$ 75	$ 6,225
6	Curb Inlet Type B	12	EA	$ 4,303	$ 51,636
7	6-foot Manhole	9	EA	$ 4,633	$ 41,697
8	Underground Detention Basin Bottom Slab	2400	CU YD	$ 400	$ 960,000
9	Underground Detention Basin Walls	153	CU YD	$ 500	$ 76,500
10	Underground Detention Basin Top Slab	2400	CU YD	$ 700	$ 1,680,000
11	Excavation	27100	CU YD	$ 20	$ 542,000
12	Sod	873	SQ YD	$ 6	$ 5,238
13	Basin Restoration	7391	SQ YD	$ 6	$ 44,346
14	Erosion Control	1	LS	$ 5,000	$ 5,000
15	Easement	1	LS	$ 1,000	$ 1,000
16	Temporary Construction Easement	11	EA	$ 100	$ 1,100

ESTIMATED CONSTRUCTION COST	**$ 3,758,641**
30% Construction Contigency	$ 1,127,593
TOTAL ESTIMATED CONSTRUCTION COST	**$ 4,886,234**
Engineering	$ 330,655
TOTAL ESTIMATED PROJECT COST	**$ 5,216,889**

*Unit costs for Items No. 2,3, and 6-8 from LFUCG Bid dated September 6, 2013
*Unit costs for Items No. 1,3, and 4 from KTC Bid dated 2012
and adjusted to reflect the LFUCG Bid prices
*30% Contigency used for potential increases in material and construction costs